

Warriors on Skis

POPULAR MECHANICS

MAGAZINE

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OUT of the AIR--
TOMORROW'S
CAR

SEE PAGE 26

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YOUR SHIPS



YOUR TANKS



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Some of the important uses to which these raw materials are being put were

born in the laboratory but a short time ago.

Despite these heavy defense requirements, quantities of "Prestone" anti-freeze were made available to American motorists, but the supply probably will not be sufficient to meet all civilian needs.

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H. H. WINDSOR, Jr., Editor and Publisher

January, 1942

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Fighting at 50,000 Feet

FROM the bombardier's window in a Flying Fortress, the battleship 30,000 feet below looks like a pinhead. Yet he can plump a bomb on that pinhead before his plane is heard or seen. Now Boeing is preparing to step the war up to the 40,000-foot level; ultimately, perhaps, 60,000. Even at 35,000, the big plane shrinks away from its paint, controls stiffen, needles on the oil-pressure dial go crazy, gasoline won't take sharp curves in the fuel line. What's being done to "soup up" plane and pilot for "Fighting at 50,000 Feet" is told in a feature next month.

Solving Mysteries of the Deep

EVER tried swordfish for dinner? It's delicious. It also has a nasty habit of ramming its sword through your boat. The reason why you eat more tuna and salmon than swordfish is that we don't know enough of the life habits of the big game fish to put it on a "quantity production" basis. But we're on the way, as you'll read in the February Coloroto pages.

Next Month

ON PATROL at 9,000 feet, the leader of a squadron of pursuit planes picks up a radio message: "Z-1 to Dog 10. Hypo 28, high, 217 degrees. Target six heavy bombers." On his map, Dog 10—that's his code name—finds "Hypo 28" and heads for the area. A fresh message from the interception office changes their course slightly. Soon they spot the foe, plunge, let go bursts of fire, reform and stab again. The story of the "Speed Demons of the Air Forces" is told in February.

Hitch Hikers Afloat

IT SOUNDS more like suicide than sport to us, but sport it is to the hardy surf riders who paddle a half mile off the California shore in the dead of winter to ride home on a 20-foot swell. You practice on the baby combers first, and you're battered and half drowned many a time before you learn. But eventually you're ready for that climactic thrill—riding the foam-topped express train as it rolls in to shore. Don't miss this February story.

Fighting Fire Bugs

G-MEN found 97 barrels of water ready to fight any outbreak of fire on a New Jersey wharf—and five gallons of fuel oil in every barrel! It wasn't sabotage. Someone was trying to control mosquitoes. But it shows how alert government, industry, fire fighters and you must be today to prevent destruction. Read "Fighting War's Fire Bugs" next month.

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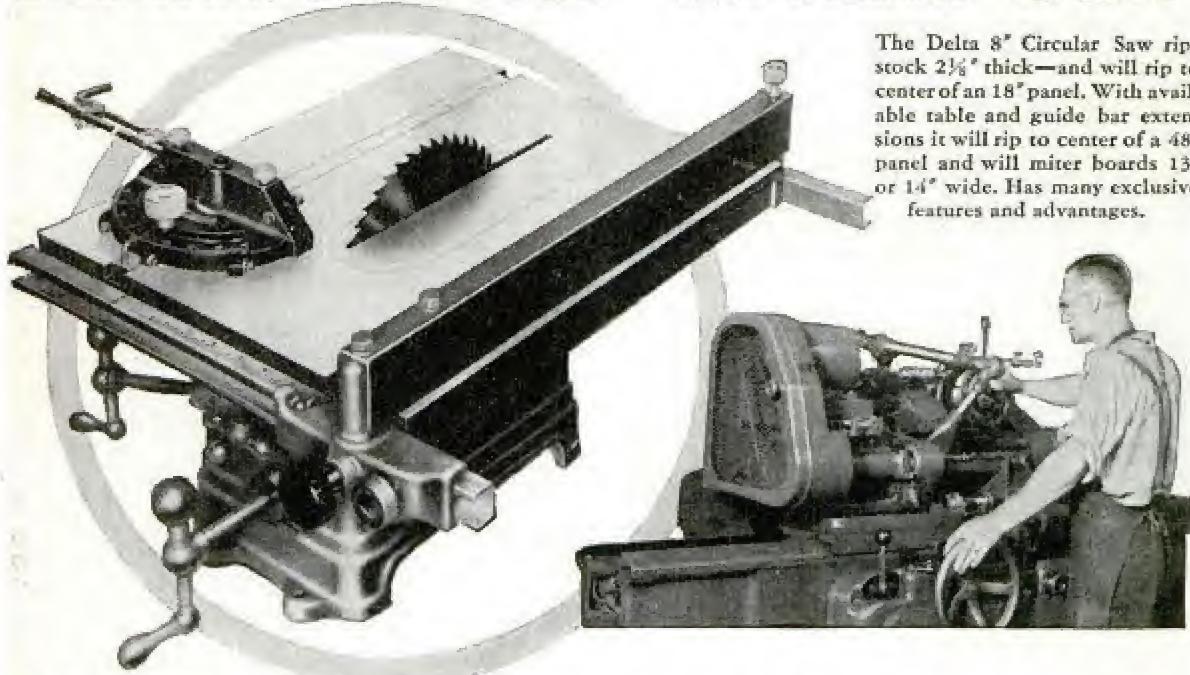
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How "PRECISION GRINDING" makes a *better* Circular Saw



The Delta 8" Circular Saw rips stock $2\frac{1}{8}$ " thick—and will rip to center of an 18" panel. With available table and guide bar extensions it will rip to center of a 48" panel and will miter boards 13" or 14" wide. Has many exclusive features and advantages.

ALL ARBORS, spindles, bearing seats, etc. on Delta machines where accuracy to close limits is important, are ground to size. Turning to size is "good enough" for many manufacturers but not for Delta machines! As shown in this illustration to the right, Precision Grinding to size, after turning, is an extra operation. It costs more money—and you can't see it as you can see nickel plating on the outside of a machine. But in a bearing or bearing seats, it provides a fit that is "all over" instead of only on a comparatively few high spots. This means that ball bearings do not become loose in service. Precision grinding produces a closer fit to more exacting tolerances, which

means that fits are uniformly good and that true interchangeability is obtained.

The extra accuracy obtained by precision grinding may be visualized when it is realized that the ordinary variation or tolerance on Delta arbors and spindles is three-ten-thousandths of an inch, and in many instances this tolerance is held to one ten-thousandth.

Send for Delta Catalog

Write for the new Delta catalog which is a complete guide book to power tools. It not only lists the entire line of Delta "Quality" wood and metal working tools—but shows you the important points to look for in all power tools. It illustrates and explains the advantages of the many hidden features of design and construction that make for long, better service in power tools. (Also send for Project Book 8 crowded with new projects, including working drawings, photographs and full instructions.)



The Delta Manufacturing Co., (Dept. 681-A)
600-634 E. Vienna Ave., Milwaukee, Wis.

Gentlemen: Send me the latest Delta Catalog listing the complete line of Delta Lathes, Circular Saws, Band Saws, Jointers, Scroll Saws, Shapers, Sanders and Drill Presses.
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THOUSANDS OF MEN ARE NOW PUSHING YOU UP TO PROMOTION AND HIGHER PAY



NEVER before have you faced the opportunity you have today.

Millions of men are going to work in expanded plants and offices; in new industries. They must have supervision; there will be thousands of new supervisory and executive jobs. Authorities agree that there is a shortage of men for these advanced jobs.

The industries haven't time to train all these executives—they must locate many men already prepared and capable. That means you—if you are ready or will get ready quickly.

These supervisory jobs will be of every kind—office, plant, accounting, traffic, legal, secretarial—they will occur everywhere. They will be in new defense plants, in plants expanded to handle defense orders, and in ordinary product plants (because many men will go from these to the defense plants or into military service).

Obviously, too, this demand will continue and grow for some time to come.

The men who act most quickly will get the most advantage from this unparalleled opportunity. They will be shoved up most quickly and farthest.

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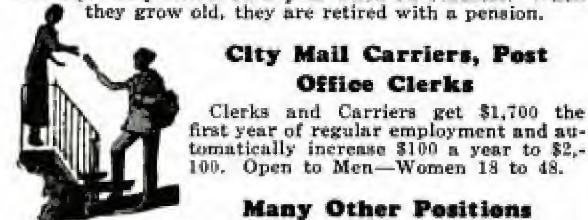
Travel for "Uncle Sam"



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Railway Postal Clerks on long runs usually work 3 days and have 3 days off duty or in the same proportion. During this off duty their pay continues just as though they were working. They travel on a pass when on business. When they grow old, they are retired with a pension.

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To men of draft age:

★ High number, low number — eventually your number will come up, and you'll be called to help out Uncle Sam in the Army.

But today's Army is a different one from the Army of 1917. Today's Army wants and needs specialists — men who are trained for more important and better paying jobs than mud slogging or spud peeling!

Thus, the selectee who is a Draftsman, a Radio Expert, a Stenographer, a Machinist, a Surveyor, an Automotive Technician, an Electrician, or who has training in some other field, stands a far better chance of reaching quickly "non-com" or "Specialist" grades than the man without training in any phase of Army work.

Where do you fit into this picture?

When your number's called, will you be another "Rear Rank Rudy," drawing the lowest base pay — or will you be qualified through sound, modern training for the much higher "N. C. O." or "Specialist" pay rates?

If you've ever thought of getting the training you lack—now's the time! For a few dollars a month, you can study an I. C. S. Course in your spare time, at home, and prepare yourself — not just for a more important Army job — but for success in civil life!

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| <input type="checkbox"/> Business Management | | <input type="checkbox"/> Cost Accounting | <input type="checkbox"/> Good English | <input type="checkbox"/> Spanish |
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HOME ECONOMICS COURSES

- | | | |
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City..... State..... Present Position.....

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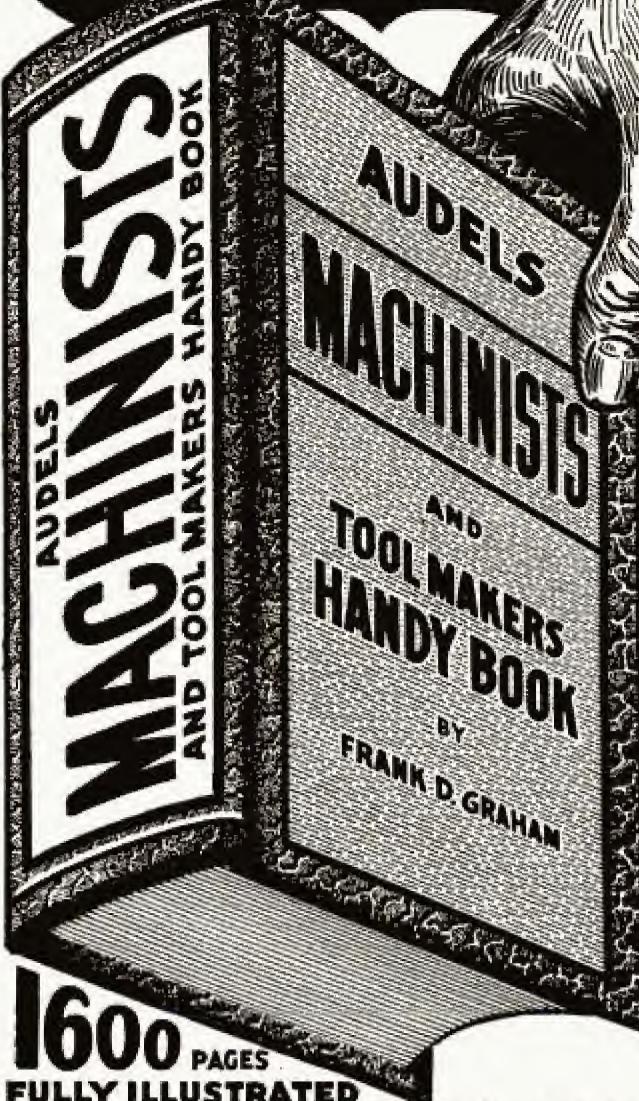
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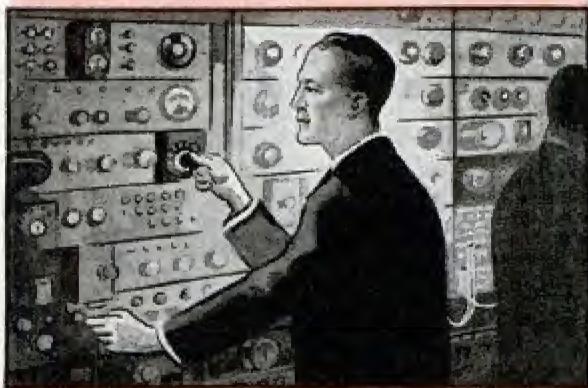




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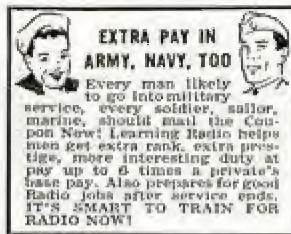
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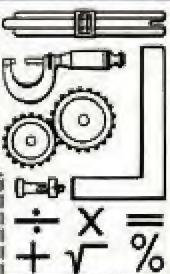
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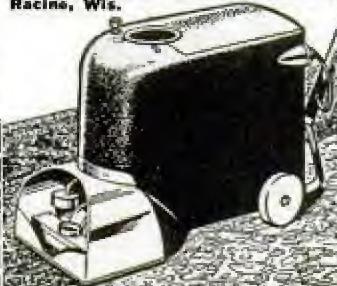
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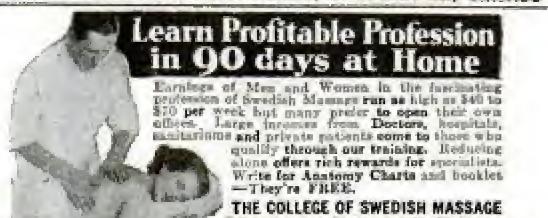


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| <input type="checkbox"/> Aviation Drafting | <input type="checkbox"/> Surveying & Topographical Drafting | <input type="checkbox"/> Mechanical Engineering |
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| <input type="checkbox"/> Business Management | <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Tool Making |
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| <input type="checkbox"/> Airplane Drafting | <input type="checkbox"/> Diesel Engines | <input type="checkbox"/> Mechanical Engineering | <input type="checkbox"/> Ship Drafting |
| <input type="checkbox"/> Architectural Drafting | <input type="checkbox"/> Electrical Drafting | <input type="checkbox"/> Mine Foreman | <input type="checkbox"/> Shipfitting |
| <input type="checkbox"/> Architecture | <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Navigation | <input type="checkbox"/> Shop Practice |
| <input type="checkbox"/> Auto Engine Tune-up | <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Pattermaking | <input type="checkbox"/> Steam Electric |
| <input type="checkbox"/> Auto Technician | <input type="checkbox"/> Foundryman | <input type="checkbox"/> Plumbing | <input type="checkbox"/> Steam Engines |
| <input type="checkbox"/> Aviation | <input type="checkbox"/> Heat Treatment of Metals | <input type="checkbox"/> Practical Telephone | <input type="checkbox"/> Steam Fitting |
| <input type="checkbox"/> Aviation Mechanic | <input type="checkbox"/> Highway Engineering | <input type="checkbox"/> Public Works Engineering | <input type="checkbox"/> Structural Drafting |
| <input type="checkbox"/> Boilermaking | <input type="checkbox"/> House Planning | <input type="checkbox"/> Pulp and Paper Making | <input type="checkbox"/> Structural Engineering |
| <input type="checkbox"/> Bridge Engineering | <input type="checkbox"/> Industrial Metallurgy | <input type="checkbox"/> Radio, General | <input type="checkbox"/> Surveying and Mapping |
| <input type="checkbox"/> Chemistry | <input type="checkbox"/> Locomotive Engineer | <input type="checkbox"/> Radio Operating | <input type="checkbox"/> Telegraph Engineering |
| <input type="checkbox"/> Civil Engineering | <input type="checkbox"/> Machinist | <input type="checkbox"/> Radio Servicing | <input type="checkbox"/> Telephone Work |
| <input type="checkbox"/> Coal Mining | <input type="checkbox"/> Management of Inventions | <input type="checkbox"/> R. R. Section Foreman | <input type="checkbox"/> Textile Designing |
| <input type="checkbox"/> Concrete Engineering | | <input type="checkbox"/> R. R. Signalman | <input type="checkbox"/> Toolmaking |
| | | <input type="checkbox"/> Refrigeration | <input type="checkbox"/> Welding |
| | | | <input type="checkbox"/> Woolen Manufacturing |

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| <input type="checkbox"/> Bookkeeping | | <input type="checkbox"/> Commercial | <input type="checkbox"/> Foremanship | <input type="checkbox"/> Salesmanship |
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| | | | <input type="checkbox"/> Managing Men at Work | <input type="checkbox"/> Traffic Management |

HOME ECONOMICS COURSES

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|---|---|--|
| <input type="checkbox"/> Advanced Dressmaking | <input type="checkbox"/> Home Dressmaking | <input type="checkbox"/> Tea Room and Cafeteria Management, Catering |
| <input type="checkbox"/> Foods and Cookery | <input type="checkbox"/> Professional Dressmaking and Designing | |

Name..... Age..... Address.....

City..... State..... Present Position.....

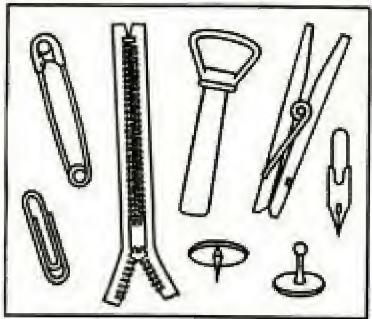
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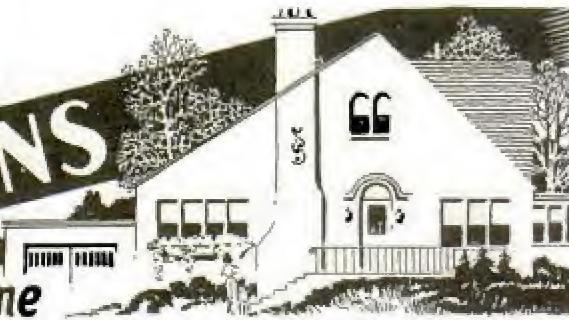
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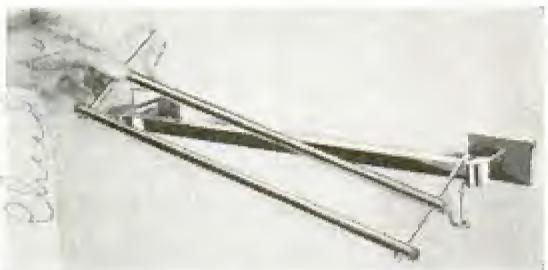


Basket Separates Clothespins From Laundry



Auxiliary Rails for Towel Rack Provide Additional Space

Towel space on the usual single-bar rack for the kitchen or bathroom wall can be tripled by using an auxiliary rack with two small arms that hook on the fixed rail. The two nickel bars of this extra rack are adjustable, sliding in and out.



Clothespins and extra line are held conveniently by a small basket that may be hung at the side of a laundry basket or slung over the shoulder by a special strap. When hanging clothes the pins remain in easy reach, and they can be tossed back into the basket while removing clothes from the line. This saves the trouble usually encountered when pins are mixed in with the clothes.

Space-Saving Ironing Board Clamps on Table Top



Any table top will form the base of an ironing board which clamps firmly to the edge of the table. It releases automatically when the tapered end of the board is raised. Forty inches long and 12 inches wide, it folds compactly to be hung in a closet.

(More Popular Inventions on page 32A)



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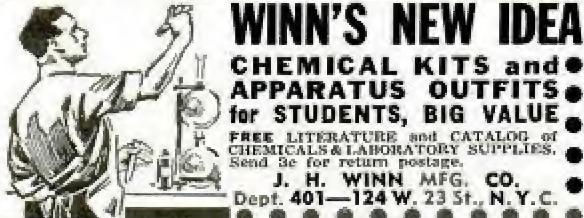
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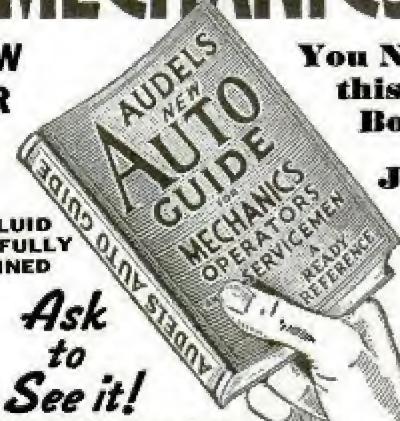
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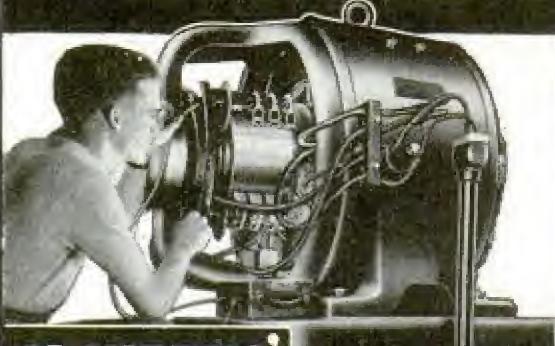


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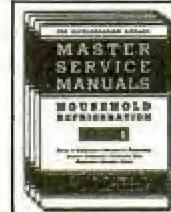
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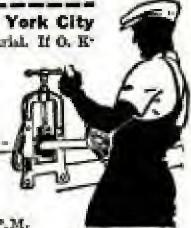
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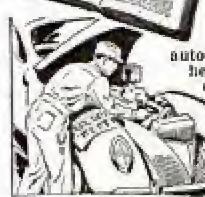
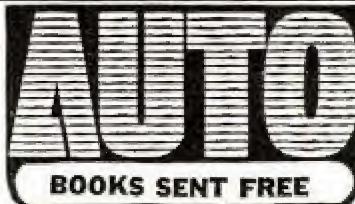
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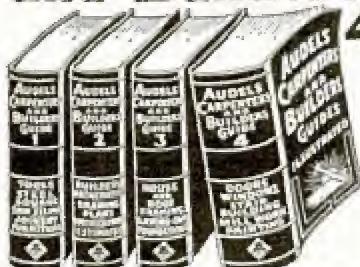
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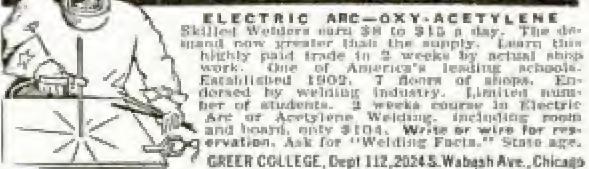
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(Continued from page 20A)

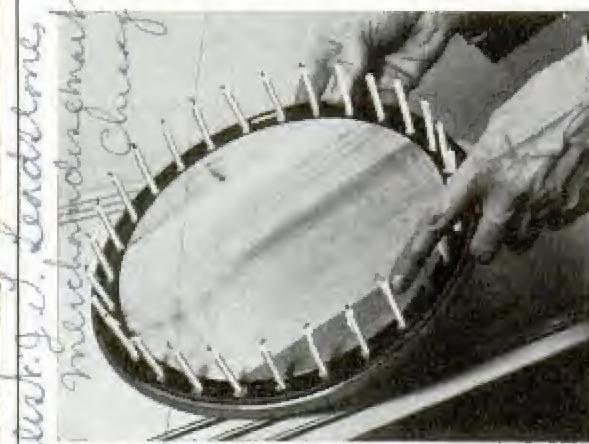
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WHERE-TO-BUY-IT INDEX OF POPULAR INVENTIONS

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"I'll Prove that **YOU**, too,
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—Charles Atlas

WEAKLING! "Sissy!" "RUNT!" Those are just some of the names the gang used to call me. And believe me, they *hurt*. Those names hurt me more than any punches ever could. I used to wish they would hit me, instead of jeer and laugh at my skinny, no-muscle physique. But I deserved it, all right. Just 97 pounds of skin and bones! No strength, no stamina. I couldn't punch my way out of a paper bag. I was ashamed, embarrassed when I had to strip for gym or the beach. I felt HALF-ALIVE.

But I began to study my body—and then I made my amazing discovery of "Dynamic Tension!" And that's what made me a **NEW MAN**. It gave me the powerful body you see here! And it won for me the title "World's Most Perfectly Developed Man!"

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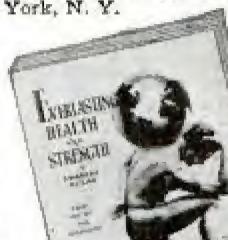
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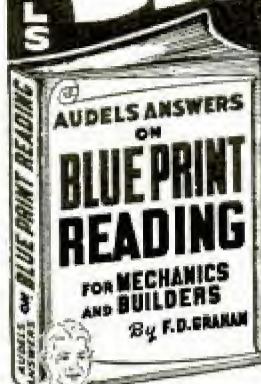
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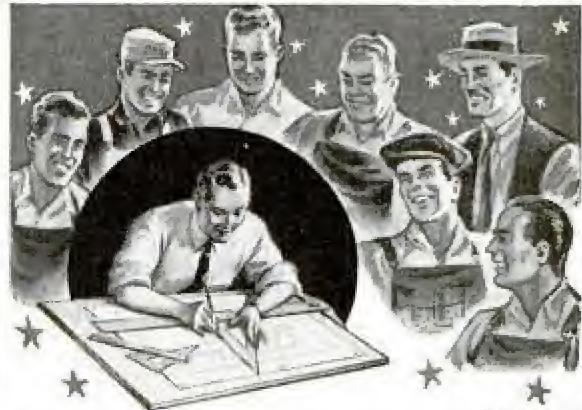
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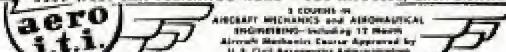
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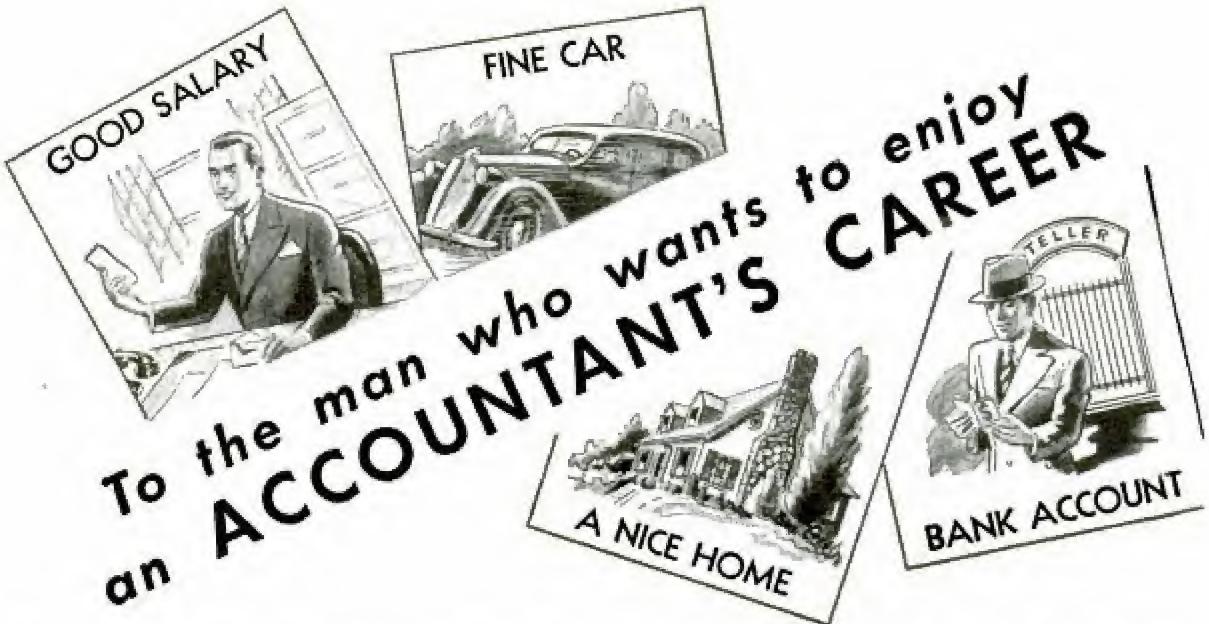
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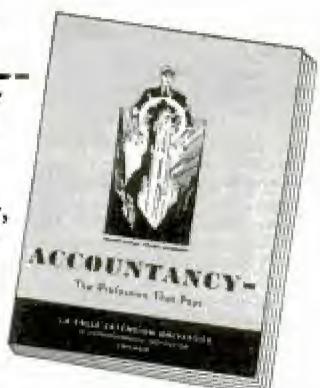
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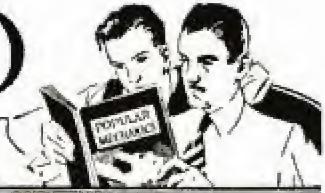
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SIX Liberia airmail triangles, complete set, 7¢, with approvals. Lorraine Brown, Marion, Mich.

SPECIAL Offer:—150 different U. S. \$2.00 (cat. \$3.00 or more). Old and new issues. Lightly cancelled. In good condition. Let us supply your needs in U. S. mint and cancelled. Reasonable. No approvals. Highest prices paid for collections and accumulations. Armour Stamp Co., St. Albans, N. Y.

1000 U. S. Mixed, containing old and recent commemoratives, high values, precancels, etc., 3¢ in coin. J. W. Dauber & Son, Bethesda, Maryland.

1000 U. S. Mixed, dime and 1¢ postage. Jim Stamps, Port Jefferson, N. Y.

WEEKLY Stamp magazine, thirteen weeks, 10¢. Stamp Journal, Kalumazoo, Mich.

FREE! Western Hemisphere packet. Postage 3¢. Owens, 806 Welsh, Bay City, Michigan.

FREE! Complete Canada royal visit with approvals. Chester, Box 545-P, Utica, N. Y.

GIANT Packet 136 all different from Africa, South America, South Sea Islands, etc. Includes Nicaragua airmail, two scarce unused United States cataloguing 20¢. Triangle and animal stamps: many others. Also includes fine collection 25 different British Colonies—Charkari, Jamaica, Johore, etc., and United States 4¢ and 8¢ high values. Total catalog price over \$4.00! Everything for only 5¢ to approval applicants! Mystic Stamp Company, Department 80-A, Camden, New York.

SOUTH American—100 different 10¢—with approvals. Davis, Silver Lake, Ind.

STAMP Dealers, your ad here will bring wonderful returns. Ask me for proof. P. W. Johnson, Manager, Classified Advertising, Popular Mechanics Magazine, 200 E. Ontario St., Chicago.

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FREE! Pony Express set (facsimiles). Postage 3¢. Roberts, 406 Building, Bay City, Michigan.

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CANADA 100 Different 25¢—approvals all countries. Lists, Victoria Stamp Co., London, 4, Canada.

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WE Buy Indian cents, Lincoln cents and old money. Send 10¢ today for advanced catalogue of prices we pay for all wanted U. S. coins. American Rare Coin Co., Dept. 1, Transportation Bldg., Chicago.

GET Profit and pleasure in collecting old coins. Send 10¢ for 56-page illustrated coin catalog. You'll be delighted with it. Send for it now. B. Max Mehl, 370 Mohr Building, Fort Worth, Texas. Largest rare coin establishment in U. S. Established 42 years.

"S" MINT Coins for sale. Parker, 408 Sutter, San Francisco, California.

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BRAZILIAN Coin collection for sale, Send 25¢ for list. Charles Gettemans, Hopewell, Virginia.

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OLD Money wanted. Will pay fifty dollars for nickel of 1913 with Liberty head (no buffalo). We pay cash premiums for all rare coins. Send 4¢ for large coin folder. May mean much profit to you. Numismatic Co., Dept. 20, Fort Worth, Texas.

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PRICE List of U. S. coins, bills and collectors' accessories 10c. 75 illustrations, 2500 quotations. James Randall, 341 South Dearborn, Chicago.

10 INDIAN Head cents, different dates, also price lists 35c. Schultz, 1053 Richmond, Cincinnati, Ohio.

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WE PAY highest prices for cameras; accessories; movie equipment; binoculars. Estimates free. Trade-ins. Brenner Photo, 943-P Pennsylvania, Washington, D. C.

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BEAUTIFUL Enlargement from each picture on roll 25c. Cut Rate Photos, Dept. B-4, Janesville, Wis.

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SAVE 50% On movies. Bargain circuit. Genera Company, Davenport, Iowa.

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NEW Film exchange plan and catalog of movie equipment. Paramount Mfg. Company, Dept. G-104, Box 224, Back Bay, Boston, Mass.

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MAKE Colorglazed concrete pottery, cementery products, tiles, floors. Basement waterproofing. Other projects. Booklet, colorplates, details 10c. National Potteries, Minneapolis, Minnesota.

SELL Books by mail on commission. No stock to carry. Orders come to you. Maywood Publishers, 1107 Broadway, New York.

Liquid Marble—Colorful, glazed! Mold, brush, spray! Composition floors, rubberlastic molds. Particulars free. Marbleizing Service, Edwardsville, Illinois.

OPPORTUNITIES For local and mail order business. Gilbert Supplies, 5 West 24th, New York.

WILL You give us 5% first \$600 you make? Afternoons free! Work home—\$1,000 month reported (exceptional—full-time). Expect surprise! National, Box 1240, San Bernardino, Calif.

CHARTERS: Delaware; best, cheapest; free forms. Colonial Charter Co., Wilmington, Del.

ELITE Collection of business plans, contains 127 tested plans and scores of formulas. Start own business: home, office. Particulars free. Elite Co., 214 Grand St., New York.

WHERE To buy at lowest wholesale prices. Information free. Yorena, Box P-312, Bayonne, N. J.

127 WAYS To make money, in home or office, business of your own. Full particulars free. Elite Co., 214 Grand St., New York.

MAKE Money by mail, the way we do. Free information. Maywood, P-1107 Broadway, New York.

SWISS Music box works—\$1.25 to \$2.10. Suitable for many novelties. Mermad Manufacturers, 147 West 46th Street, New York.

PAINT Signs for profit, with aid of lettering patterns. Free literature. Sample alphabet 5c. Display Letters Company, Box 28-M Ft. Hamilton Station, Brooklyn, N. Y.

YOUR Ad in this space will bring amazing results. I'll prove it to you. Write at once for interesting information. F. W. Johnson, Room 300, 200 East Ontario St., Chicago.

MONEYMAKING OPPORTUNITIES

BOOKKEEPERS—Profitable accounting work (office or home) for experienced bookkeepers. Ralph Lee, Vicksburg, Mich.

MAKE Your own Flexible Molds. Statuary, Art Goods, Novelties, Artificial Marble, Flooring, Liquid Marble. Literature free. Kemico, 100-M, Park Ridge, Ill.

EARN Money evenings, copying, duplicating cartoons for advertisers. Ad-Service, Argyle, Wis.

YOU'LL Like resilvering mirrors, tableware, making chipped glass nameplates, signs. Outfit prices. Sprinkle, Plater, 287, Marion, Indiana.

AMAZING Opportunities, unbelievable propositions. Positively legitimate, 3c stamp. Capitol Mailers, 712 Wayne Ave., Dayton, Ohio.

OPERATE A mail order business at home! Zillman, 4440 North Kildare Avenue, Chicago, Ill.

HUNDREDS Money making plans, formulas, secrets. Write, DeLuxe, Pittsburgh, Ill.

AMAZING New 15-way profit mail order business plan. Few dollars starts. Details, write—Bradley's, Box 1871-M, Raleigh, N. C.

HOME Work pays handsome profits. Star, Box 7055, Portland, Oregon.

EARN Living at home! Information free. Big mail 10c. Thompson, 824 North 8, Council Bluffs, Iowa.

100,000 ARTICLES. Buy wholesale. Valuable supply source directory 10c. Ideal Service, D-12, Park Ridge, Ill.

100 MONEY-MAKING Suggestions 25c. Satisfaction guaranteed. George Beach, Hanover, Mass.

SELL Books, plans, by mail. No stock to carry. Large list and complete plan, one dime. Graham, Real Estate Trust Bldg., Philadelphia.

WOMEN: Make money at home, 100 ways, 64 pages, postpaid 25c. Clever Ideas, Ashburn, Georgia.

REFINE Old crankcase oil. Also simple way to convert into fuel oil. Each 50¢. Both \$1.00. Wayne Engineering, Dept. 9, Greenville, Ohio.

"PROGRESSIVE Mail Trade" published monthly—68 pages—offering latest mail-order projects; services, business starters. Copy 10c. Publishers, Box 115-C, Gardenville, N. Y.

300 MONEYMAKING Opportunities, only 10c. Peterschmidt, 139 Locust, Quincy, Ill.

YOUR Name on my mailing list. Monymaking magazine 10c. Shields, 322-D Shaw, Taylor, Texas.

START Own typing service. Folio business building ideas. 50c. Richard Publishing, 4340 Maple, Dallas, Texas.

FIVE Amazing moneymaking plans 25c (each). R. Devault, Gainesville, Texas.

MAKE Money at home. We do. Nassau Co., Winston-Salem, N. C.

MAKE Cuts from photos and drawings. Simple. Inexpensive. Both processes \$1.00. Lucius Dawson, Box 20PM, Station "J," New York.

BE A metascientist. Remarkable drugless healing system. No manipulation, no apparatus. Inexpensive correspondence course. Free information. Metascience, Deland, Florida.

TYPISTS, Added incomes. Homework, Literature, stamp. Susquehanna Service, Steelton, Penna.

YOUR Name on 3,000 mailing lists—25c. Get free samples, opportunities galore from all over world. Eastern, P-961—46th, Brooklyn, N. Y.

EARN Money at home! Thousands do! "Home Worker Magazine" tells how. Sample, 25c. Sizemore, Box 7, 4817 North Kostner, Chicago.

BE A professional scrapbooker. Big fees. Unlimited opportunities. Can be done at home. No competition. No capital needed. Write to Scrapbookers Guild, 59 Park Place, New York, New York.

WILL You give us 5% first \$600 you make? Afternoons free! Work home. \$1,000 month reported (exceptional—full-time). Expect surprise. National, Box 1240, San Bernardino, Calif.

TWENTY Dollars daily reclaiming lube. Bolset, Box 483, New Orleans, La.

WHOLESALE Sources, 500,000 articles. Free directory. Maywood, 1107 Broadway, New York.

FORMULAS, PLANS, ETC.

ATTENTION—Women, cook book \$1.00, 416 pages. Men, 1000 formulars \$2.00, 638 pages. Miller's Specialty Service, Box 1127, Poughkeepsie, N. Y.

NEW! Foaming (soapless) formulas. Also one ingredient formulas—no manufacturing! Information free. A. Kintord, Wayne, Pennsylvania.

REMARKABLE Wetting-agent—formulas free. Cambridge Laboratories B-1, Wellesley, Mass.

FREE Formula catalog, anything analyzed \$10.00. Western Chemical, Salem, Oregon.

1,000 CHOICE Formulas—25c. 10,000—\$1.50. Hill, 6020-B Harper, Chicago.

200%-1000% PROFIT Using Victor exclusive analytical formulas, processes! America's twenty spectacular specialties. Unusual plan. Brochure free! Victor Race, Dept. D, Norwalk, Connecticut.

25 NEW, Secret, one ingredient formulas 25c. Northwestern, 1428-M 1 West 62, Seattle, Wash.

CHEMICAL Formula reading explained. 25c. Dr. Cecil Corwin, Hayward, Calif.

FORMULAS, General, technical, guaranteed. List free. W. B. Mann, Chemical Engineer, Haledon, Calif.

MAKE Fast selling products. No machinery. "Chemist Approved Formulas." Catalog free. Kemico, 12-P, Park Ridge, Illinois.

SIMPLIFIED Formulas—Newest kind. Surprising literature free. Baran, Bay City, Michigan.

AUTHENTIC Formulary, 924 pages. (Illustrated.) Recipes, Instructions—10,000 profitable products. \$1.50 postpaid or C.O.D. (Foreign \$1.85). Catalog 3c. Adams Brown Company, Chestnut Hill, Massachusetts.

REAL Manufacturing formulas. Lists free. Cummings, Chemist, Gordon Ave., Syracuse, N. Y.

ELITE Formulas and plans; make and sell your own products. Descriptive booklet free. Elite Co., 214 Grand St., New York.

FORMULAS—Latest, best. Analysis, Literature free. Belfort, Engineering Building, Chicago.

CHEMISTRY

WINN'S New idea chemical kits and apparatus outfits for students, big value. Free literature and catalog of chemicals and laboratory supplies, scientific books at big discount. Send 3c return postage. JE-1 Winn, 124 W. 23rd St., New York.

CHEMICALS In 5c quantities. Catalog 5c. Box 58, Elizabeth, N. J.

CHEMICALS 5c Quantities, List 3c. Delta Sales Co., Chalmette, La.

CHEMICALS—Sc Quantities, apparatus, catalog 5c. Fleischer's Laboratories, Medford, Mass.

SOILLESS, Colchicine, plant experiments magazine, Subscription \$1.00. Questok, Wellesley, Mass.

FREE Chemical booklet, formulas, bargains, Rankin, Clover Bldg., Kansas City, Mo.

MONTHLY Chemistry Magazine, 6204-N Hermitage-F, Chicago. Year, 75c; sample 10c.

FREE Catalogue, Chemistry, mineralogy, biology, microscopes, telescopes, Tracey Laboratories, Evanston, Illinois.

SPECTROSCOPE For quick chemical analysis \$2.50. Kutting Sons, Campbell, California.

HELP WANTED

LOCAL Agents wanted to wear and demonstrate suits to friends. No canvassers. Partial payment plan. Up to \$12 in a day. Experience unnecessary. Valuable demonstrating equipment, actual samples free. Stonefield, 1300 Harrison, Dept. A-817, Chicago.

NATIONAL Job Reporter (bi-weekly) furnishes confidential information high-pay defense jobs throughout country. Six months' subscription \$3.00. Single copy 50c. Room 318, 118 East 28th, New York.

AGENTS WANTED

AGENTS—Silk and Nylon hosiery. Big stock; complete line; all sizes. Selling like wild. Whirlwind profit opportunity. Replacement guaranteed. Your own hose free with large outfit. Rush hose size, name today. Wilknit, Desk CA-37, Greenfield, Ohio.

SCHOOL Seniors—Sell graduation cards. America's largest, fastest-selling, low-priced display. 35% commission. Free cards. Universal Engraving & Printing, Box 345-M, Pittsburgh, Penna.

CASH In on defense program. New low priced seller. Splendid profit. Write Henry Krebs, Haddon Heights, New Jersey.

WRITE For free fabric samples amazing stainproof tablecloths. Clean with damp cloth. Require no ironing. Beautiful patterns. Look expensive, long wearing, low priced. Commission big. Also complete dress line. Melville Company, Dept. 3054, Cincinnati, Ohio.

WANT Pleasant outdoor work in a business of your own? Good profits selling over 200 widely advertised Rawleigh home farm necessities. Pays better than most occupations. Hundreds in business 5 to 20 years or more! Products-equipment on credit. No experience needed to start—we teach you how. Write today for full particulars. Rawleigh's, Dept. A-145-PPM, Preprint, Ill.

PATENTED—Protects men's pants from fraying and wear—bottoms of cuff. No competition. National Trouser Guards, Shreveport, Louisiana.

KNIT For defense. Auto knitter machine makes pair military socks hourly. Also mufflers, caps, mittens. Demonstrate in department stores, relief agencies, knitting groups. Write for proposition. Almstall Knitting Machine Co., 750 Grand St., Brooklyn, N. Y.

DEFENSE Workers. Defend your hands with chafing, grittiness handsoap. Trial size quarter, T. L. DeCamp, Sta. "A," Cincinnati, Ohio.

YOU'Ll Like resilvering mirrors, tableware, making chipped glass nameplates, signs. Outfit prices. Sprinkle, Plater, 128, Marion, Indiana.

FREE Water and our concentrates make 72 products. We supply labels, bottles. Enormous profits. Qualeco, E-20030 Russell, Detroit.

NEW Vestpocket Halex just out on attractive display card. Instantly relieves nose colds, headache, hay fever and sinusitis. Sells itself. Halex Company, Sappington, Mo.

DRESSES, Used 10c, shoes 50c, coats 75c, hats 40c. Free catalogue. Crown, 164-PM Monroe Street, New York.

SELL Goyava, delicious imported confection, nourishing, palatable, healthful. Big, steady sales. Profits up to 50%. Send 60c for 2½ pound sample or write for details. R. Valles, 311 Church Street, New York.

SPECTACULAR Demonstrator. Make sell it yourself. Details, O-Belfort, Engineering Building, Chicago.

STRANGE Chemical sponge cleans wallpaper like magic. Banishes housecleaning drudgery. Sensational seller. Samples sent on trial. Rush name. Kristee, 131, Akron, Ohio.

STILL Nylon hosiery and famous snag-protected silk hosiery. Sensational profit opportunity. Write fully for free selling outfit. American Mills, Dept. F-188, Indianapolis, Ind.

SELL Dresses low as \$1.24. Hundreds sensational bargains. Actual samples free. Send dress size, age. Harford, Dept. F-382, Cincinnati, Ohio.

GROCERIES Free. Just agree to show friends, neighbors, others and I'll give you \$5.00 assortment foods, groceries, etc. Free. Amazingly simple way to make good money. Send no money—just name and address. Zanol, 6238 Monmouth, Cincinnati, Ohio.

START Life-time repeat business on \$5.00, \$1.00 profit on \$1.20 sale. Millions waiting. Free offer. Thermolife, Peoria, Ill.

15 FAST Sellers, Big profits. Samples 10c. Box 120M, Arkansaw, Wis.

61 TESTED Money making plans and 29 formulas 25c. Particulars free. Beck, Box 71, Roscoe, Calif.

NECKTIES Ready-made. Sensational item, beautiful materials. Salesman's sample 25c. Write Zip-On Neckwear Co., 425 Market St., Philadelphia, Penna.

AMBITIOUS School seniors—Sell class-mates the "tops" in graduation name cards. Best commissions. Free cards. Agencies going like wildfire. Hurry! Craftsmen, Box 235-L, Pittsburgh, Penna.

AGENTS. New fast selling article. Write quick. W. Arens, 1049 12th Ave., Columbus, Ohio.

AGENTS. Big line including food products. Fast selling premium and bargain deals. Low prices. Send card for big outfit offer with gift. Ho-Ro-Co., 2701 Dodier, St. Louis, Mo.

MEN'S—Ladies' topcoats 35c, winter coats 40c, suits 88c, pants 23c, dresses 19c. Other used, new bargains. Catalog free. Fortney, 560-V Roosevelt, Chicago.

AGENTS—300% Profit selling Gold Leaf Letters; stores and offices. Free samples. Metallic Letter Co., 438-B North Clark, Chicago.

SCHOOL Seniors sell graduation cards. Free cards. Printex, Roanoke, Va.

AMAZING Cleaner! Makes cleaning easy. Premium deals gets orders. Free sample. Zimco, 5007 Irving Park, Chicago.

COMIC, Clever Xmas folders. Samples, Straley, 1015 Mulberry, Springfield, Ohio.

BIG Money applying initials on automobiles. Easiest thing today. Free samples. If you sell printing and advertising specialties we have an excellent sideline featuring Decalcomania name plates in small quantities. "Ralco," 727 Atlantic Ave., Boston, Mass.

WINDOW Sign letters. New "Roman" style. Large sizes, penny each. Absolutely beautiful. Free samples. New catalogue. Atlass, 1941 Halsted, Chicago.

GAS Stations want this new patented necessity. Knipp, Long Beach, California.

"FREE!" Mexican curios, novelties. 100% profit! Marquezp, Apartado 1176, Mexico City.

GOOD Paying business silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures by late method. Free particulars and proofs. Gunmetal Co., Ave. N, Decatur, Ill.

AGENTS—To mail our literature. Good profits. Home business. Maywood, 1105-1107 Broadway, New York.

HIGH-GRADE SALESMEN

GREATEST Christmas profits! Fifty imprint cards 20c; dollar box assortments 33c; calendars, wreaths, pictures, novelties. Catalog free! Three boxes \$1.00. Fantus, 440 North Wells, Chicago.

DECALCOMANIA Transfers bring big profits to printing specialty salesmen. Quick, easy sales. Stock designs. Samples free. Ideal Decalcomanias, Box 4455, Atlanta, Georgia.

BIG Commissions—selling to stores celluloid pricing tickets, metal shelf mouldings. To restaurants, menu covers, signs. P. Princis Press, 124 White St., New York.

NEW Specialty—Sells every business and professional man. Four \$15 sales daily pay \$270 weekly. Farrell cleared over \$1,000.00 monthly. Write, F. E. Armstrong, President, Dept. PM, Mobile, Ala.

SELL Business cards, stationery, book matches, gummed tape, restaurant necessities, salesbooks, advertising specialties, pencils, picture cards, tags, pricing sets. Lowest prices. 40% commission. Experience unnecessary. Free deals. Sales portfolio free. Willens, 2130 Gladys, Dept. 41, Chicago.

SALESMEN. Make money every day. Sell standardized printing and sales books. Ideal Press, 4373 Melrose, Los Angeles, Calif.

ANOTHER Collection system boom. Plan established over fifteen years. Big commission. Double Bonus, 204C Calvert Street, Baltimore.

AT HOME, your own manufacturing business, making popular \$1 novelties. Cost you 3¢ to 15¢. Everything supplied. Write So-Lo Works, Dept. E-842, Cincinnati, Ohio.

BLADES—Big profits. Best quality. Factory prices. Ace Blades, Buffalo, N. Y.

BIG Profits selling counter card products and sundries. Kittrell Company, 517 Bluff, Waterloo, Iowa.

YOUR Name on household polishes—100% profit. Brinco, 62 Lake Station, Minneapolis.

ADVERTISING Book matches. America's largest manufacturer of union label book matches. Fast selling line. Large sales producing kit. Sample matches. Complete cut catalog. 13 color combinations makes selling easy. Commission in advance. Superior Match Company, 7530 Greenwood, Dept. N-1, Chicago.

SELL Fluorescent lights. Sales kit; stamp, J. W. Millar, 1424 Jackson, Chicago.

ADVERTISING Book matches—World's largest "direct selling" book match factory offers advanced cash earnings calling on every type of business. Experience unnecessary; full, part time. Low prices for high quality; quick deliveries, help you get orders. Good repeat profits. Free kit instructions. Match Corp. of America, 3433 West 48th Pl., Dept. E-1, Chicago.

MAN With car to establish retail store route. Openings almost every locality. Handle orders for nationally known manufacturer-jobber. Average 30% commission. Steady big pay opportunity. Sales experience unnecessary. World's Products Co., Dept. 101, Spencer, Ind.

DISTRICT Representatives—Permanent territory, a business of your own—by LaSalle Extension University, a correspondence institution. Thorough training, much national advertising, liberal commission. Requirements—good personality, ability to counsel with prospects, will to work, a car. John D. Morris, 4113 S. Michigan, Chicago.

CLEAN UP now till Xmas. Fast selling perfume beads. Low prices. Big profits. Mission, 2328 West Pico, Los Angeles, Calif.

EXCELLENT Opportunity selling our complete line of brushes, largest commissions. Write for sales plan. Wire Ohio Sanitary Brush Company, 2300 5th Ave., New York.

EARN Money in your spare time taking subscriptions to Popular Mechanics. Unlimited possibilities, every family a prospect. Easy to sell. Bonus paid in addition to liberal commission. Send postcard for further details today. Circulation Dept., Popular Mechanics Magazine, 200 E Ontario St., Chicago.

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ARITH-MAGIC—(Not a machine)—Solves all problems in arithmetic with unfailing accuracy in 1/10th the usual time, with 1/10th the usual effort. Postpaid one dollar—worth a hundred. Wonderful gift. Arith-Magic, Dept. 21, Maywood, Ill.

BIG Demand for trained auto mechanics, body men and welders. Practical training. Free catalog. Hanson School, Box 1780-C, Fargo, N. Dak.

FOR An extremely profitable lifetime business, operate a collection agency-credit bureau. Inexpensive short course. Write Cole Associates, Syracuse, N. Y.

LEARN Aircraft, auto mechanics, body repairing, welding, electricity. Stevenson's, 2088A Main, Kansas City, Mo. Established 1922.

WELDING—Electric arc. Learn profitable trade quickly through actual practice. Individual welder instruction at bare cost of materials. Full particulars free. Valuable welding lessons book 50c. Hobart Welding School, Box M-129, Troy, Ohio.

NEW Writers needed! Free test shows your ability. It's fun! We show what to write, help you sell. Rush postcard. No obligation. Comfort Writer's Service, Dept. 186-J, St. Louis, Mo.

FINGER Print experts earn big pay! Learn easily at home. Low cost! "Crime book" free. Write stating age. Dept. 210, Inst. Applied Science, 1920 Sunnyside, Chicago.

ENJOY Health. Become professional acrobatic. Free health book. Write Emil Knoff, 2154ML North 52nd Street, Milwaukee, Wis.

COLLEGE And seminary subjects correspondence courses. Write Penmarra University, Box 21, 100 W. Saratoga Street, Baltimore, Maryland.

PREPARE For post office examinations. For free literature write Lakeview Preparatory School, Department P, 1280 East 114 Street, Cleveland, Ohio.

LEARN To write fillers, short articles, gags. Folio of procedure, information, markets, \$1.00. Richard Publishing Service, 4340 Maple, Dallas, Texas.

"**UNCLE Sam**" jobs. Commence \$105 to \$115 month. Men-women. Prepare now at home for examinations. Full particulars—list of positions, free. Write today, Franklin Institute, Dept. F2, Rochester, N. Y.

MASSAGE, Hydrotherapy, druzes therapeutics, physiotherapy, chiropody, taught by mail. Evans Correspondence Courses, P.O. Box 1199, San Antonio, Tex.

LIFE Is a mission. Learn how to fill it and be happy. Wonder Studies, 909 Lakeside Place, Studio A, Chicago, Illinois.

TOOL Engineering—taught the practical way, pay as you learn. The Tool Engineering Co., 630 N. Taylor Ave., Oak Park, Ill.

MATHEMATICAL Short-cuts. Forty lesson course \$1.00. Slide rule free. Vocational Institute, Box 434, Duluth, Minn.

DESIGN Engineering pays big. Home study course. Low cost. Easy terms. Free booklet. Ohio Institute of Technology, Box 40, Greenville, Ohio.

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PART Time bookkeeping pays big. Easy payment course. Fireside Educational Institute, 5542-P South Homestead, Chicago.

WELDING Opens the way to good pay and future in important industries. Growing need for trained welders. Prepare now. Practical, personal training, spare time at home and Chicago. Write for free facts. Utilities Engineering Institute, 1314 Belden, Dept. 121, Chicago.

IMMEDIATE Openings for arc welder students in expanded famous Lincoln school. Big opportunity for learning arc welding. Now in big demand. Bright future. Write Lincoln Welding School, 12818 Colt Rd., Cleveland, Ohio.

BEST Pay trades all times: short terms. Low cost. Catalogue free. Clean interesting work. Decorating, paperhanging, graining, marbling, sign and pictorial work. Chicago Painting School, 102 West Lake Street, Chicago.

LEARN Telegraphy! Splendid opportunities now prevail. All expenses low. Catalog free. Dodge Institute, Hiatt Ave., Valparaiso, Indiana.

BE A doctor. Learn chiropractic. Fast growing profession. Write for catalog—Dept. D, Texas Chiropractic College, San Pedro Park, San Antonio, Texas.

LEARN Artistic plastic mold making, engraving, designing, lettering, etc. The practical way, for full details, samples, write Harry F. Renzelman, 434 Elm St., Cincinnati, Ohio.

BECOME A Doctor of Psychology (P.s. D.) Teach secret of contentment, happiness. Solve mental worries. Free book. College of Universal Truth, 20-B East Jackson, Chicago.

LOCKSMITH Course. Lock picking, key fitting, etc. \$1.00 prepaid. Locksmith, Canadian, Texas.

LEARN Watchmaking. Material instructions for start and wholesale supply catalog. all \$1.00. Refund not satisfactory. Stewart's, 721 Olive St., Louis, Mo.

CLINICAL Laboratory technic taught in your own home. Practice outfit supplied. Bulletin free. Imperial Technical Institute, Box 444-E, Elkhart, Indiana.

SECRET Investigation. Experience unnecessary. Detective particulars free. George Wagner, M-2840 Broadway, N. Y.

PLAYS, STORIES, MANUSCRIPTS

WRITERS! Send 10c for "Story Writing Self Taught." Worth \$10.00. Gascony Co., Dept. 61, 541 S. Spring, Los Angeles, Calif.

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EARN Money evenings, copying, duplicating cartoons for advertisers. Ad-Servi-ice, Argyle, Wis.

DRAW Animated cartoons for the movies. Complete illustrated instructions \$1.00. Natl. Falk, 3933 46th Street, Sunny-side, N. Y.

CARTOONING Course—30 illustrated lessons, over 500 sketches, drawing paper, pens and pencils, complete, \$1.00 postpaid. Montes Studio, Box 989, Pasadena, Calif.

CHALK Talks. Laugh producing program, \$1.00. Catalog 10c. Balda, the Cartoonist, Oshkosh, Wisconsin.

HIGH Grade art work and lettering done at reasonable cost. A. Thaurau, 3200 Franklin Blvd., Cleveland, Ohio.

MONEY In portrait sketching. Progressive steps teach you. 20 complete lessons \$2.00. Harold Parks, Ypsilanti, Mich., R. 3.

PEN And ink drawings. Let us draw your advertising and catalogue illustrations, from photos, copies or objects. Best work and fair prices. Heraldic Studios, 1914P Oakdale Avenue, Chicago, Ill.

BUSINESS SERVICE

PERSONAL And business mail received and re-forwarded. Dunn Mail System, Box 42, 216 West 69th Street, New York, N. Y.

PHILADELPHIA, Pa., mail receiving, reforwarding. Other services. Graham System, Real Estate Trust Bldg.

CHICAGO Mail address: \$1 monthly—Receiving, reforwarding your business, personal mail. General, 30 West Washington, (Established 1919).

ADVERTISING AGENCIES, LETTER WRITERS, FOR ADVERTISERS

MAILING List, 50,000 Chicago births, parents, \$2.00 per thousand. Address Price, 1208 South Kolin, Chicago.

ADVERTISE Profitably: \$15 reaches 5,000,000 Sunday newspaper readers with 24-word ad. Newspaper, magazine, mailing-list ratebook, free. Chicago Advertising Agency, 20-PA West Jackson, Chicago.

MAGNETIZE Your letter, circular, or advertisement with vital new success ideas! Sincere help by expert creative writers. Criticism \$3, revision \$5, rewriting entirely \$10. Fast airmail service. Scribes of Inspiration House, Westport, Connecticut.

ADVERTISE: 30 Words 2 leading mail-order magazines, 3 times, 72,000 circulation. \$4.00. Proof guaranteed. Sample copies 25c. Northwestern Advertising Co., 1428-PM West 63, Seattle, Wash.

ADVERTISE: 24 Words, 145 newspapers \$8.50. Lists free. Advertising Bureau, 4515-C Cottage Grove, Chicago.

LEARN Advertising at home. Easy practical plan. No text books. Common school education sufficient. Interesting booklet and requirements free. Page-Davis School of Advertising, 1315 Michigan Avenue, Dept. 343C, Chicago.

FREE—New Advertisers Rate Guide, 44 pages. Includes everything. Lowest rates. E. H. Brown Advertising Agency. Merchandise Mart, Chicago.

ADVERTISING Placed all magazines, newspapers U.S.A., Canada. Lowest rates. Free service. 34-page catalog free. Baker Advertising Agency, A-189 W. Madison, Chicago. Established 29 years.

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3 LINES 25c; Indexed 35c; signatures \$1.50. Stamprite, Wauwatosa, Wis.

BEST: Quickest! 2 lines 25c; 3—35c; cushioned. Aeroflates, Lacrosse, Wis.

ARMY, Navy, service. Three lines 35c; four 50c. Indelible marking outfit \$1.00. Slocum, 614 Bradley, Peoria, Illinois.

KNOB Handle, cushioned, 2 lines 25c. 3—35c. Stamp Works, Centerport, N. Y.

2 LINES 25c, 3 Lines 35c. Stamp Works, Auburn, Nebr.

TYPEWRITERS, DUPLICATORS, OFFICE DEVICES

"NEW Process" stencils for all makes duplicators, 5 quires (120) \$8.75. One quire \$2.00, inks and supplies. Automatic post card stencil printers \$6.75. Write Pittsburgh Typewriter Supply, Department K-22, Pittsburgh, Penna.

TYPEWRITERS. Adder, mimeograph, multigraph, addressograph. Send for free lists of machines that will help you at half price. Pruitt, 28 Pruitt Bldg., Chicago.

PRINTING, MULTIGRAPHING, MIMEOGRAPHING, GUMMED LABELS

NICE Job printing. Inexpensive. Mail copy. Brink, 1130 Holmes, Menomonee, Michigan.

PERSONAL Stationery \$1.00. Samples for stamp. Springer Press, Miami, Okla.

500 LETTERHEADS, Billheads, or envelopes, \$2.50 postpaid. Leader, Lakemills, Wisconsin.

100 8½x11 TWENTY Pound bond letterheads and 100 6¾ envelopes \$1.00 postpaid. Bennerville, 907 West Roosevelt, Philadelphia.

QUALITY Printing at bargain prices. Samples. Write, Publishers, Dept. M, Harbor Springs, Mich.

EVERYTHING Printed, wholesale prices. Free list. Midwestern Printing Co., Springfield, Missouri.

PICTURE Labels—700 designs 10c. Re-usable. Arrowprint, PM142, Waterbury, Connecticut.

SNAPPY Labels, pleasing prices. Samples. Harvey Labels, Columbia Station, Ohio.

500 ELEGANT Envelope enclosures, \$3.75. All printing low prices. Samples. Goodprint, Harrisonburg, Va.

100 LARGE Envelopes, 100 letterheads \$1.00 prepaid. Crown Print, Adelphi, Ohio.

PRINTED, 125 Each, 75c. Quality too. Delmont Publishing Co., Delmont, Penna.

PRINTED Necessities: Reasonable, sample set free. Business Specialties, Urbana, Ohio.

500 STICKERS, 2½x¾, 25c. New catalog. Labels, Cott's, Waverly, Kansas.

QUALITY Printing, mimeographing—unparalleled. Low prices. Samples free. Flame Press, Lathrop, Calif.

QUALITY Printing, low prices, samples. Spender & Son, Columbiaville, Mich.

100 NAME Cards printed 50c. Free case. Printex, Ronckie, Va.

500 3½x2¼ FOUR Line gummed stickers, 25c. Morris Printery, Saginaw, Mich.

JOB Printing. Quick, reasonable. Samples. Atlantic, Box 653-H, Rock Hill, S. C.

250 LETTERHEADS, Envelopes, billheads, cards. Combination \$3.50. Economic Press, Legion, N. J.

HAMMERMILL, Letterheads, envelopes, all colors, 32 styles type. Free particulars. Woodruff's, 217-A Lewis, Duluth, Minn.

500 BOND Letterheads 8½x11. \$1.50. Samples. Birchwood Printers, East Paterson, New Jersey.

PRINTING OUTFITS AND SUPPLIES

PRINT Your own cards, stationery, circulars, advertising. Save money. Simple rules furnished. Print for others, nice jobs. Junior outfit \$2.25, senior outfit \$10.55. Details free. Kelsey, Inc., P-11, Meriden, Conn.

PRESSES Bought, sold. What have you? List 3c. Meigs, 190A Cook, Meriden, Conn.

HAND Power presses. Complete bargain bulletins. Send stamp. Bradshaw, 3214-P Huron, Chicago.

PRESSES, Type, supplies. List free. Catalog ten cents. Model Press Co., York, Penna.

INEXPENSIVE 6x9 Printing press. Details free. Novelty Shop, Downsville, Louisiana.

PRINT At home. 10c will bring a complete catalog of presses, type and supplies. P. Pfeiffer & Company, 8 Columbia St., Newark, N. J.

BARGAINS — Presses, type, supplies. Send stamp. 159 Harvard, Cambridge, Mass.

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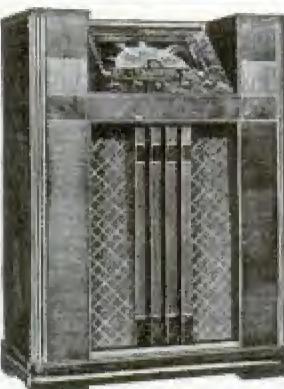
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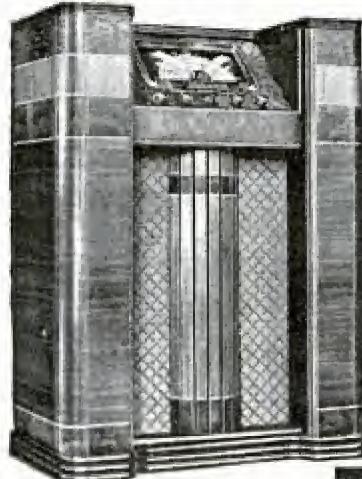
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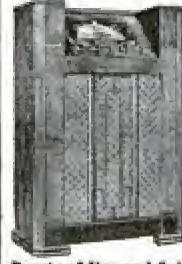
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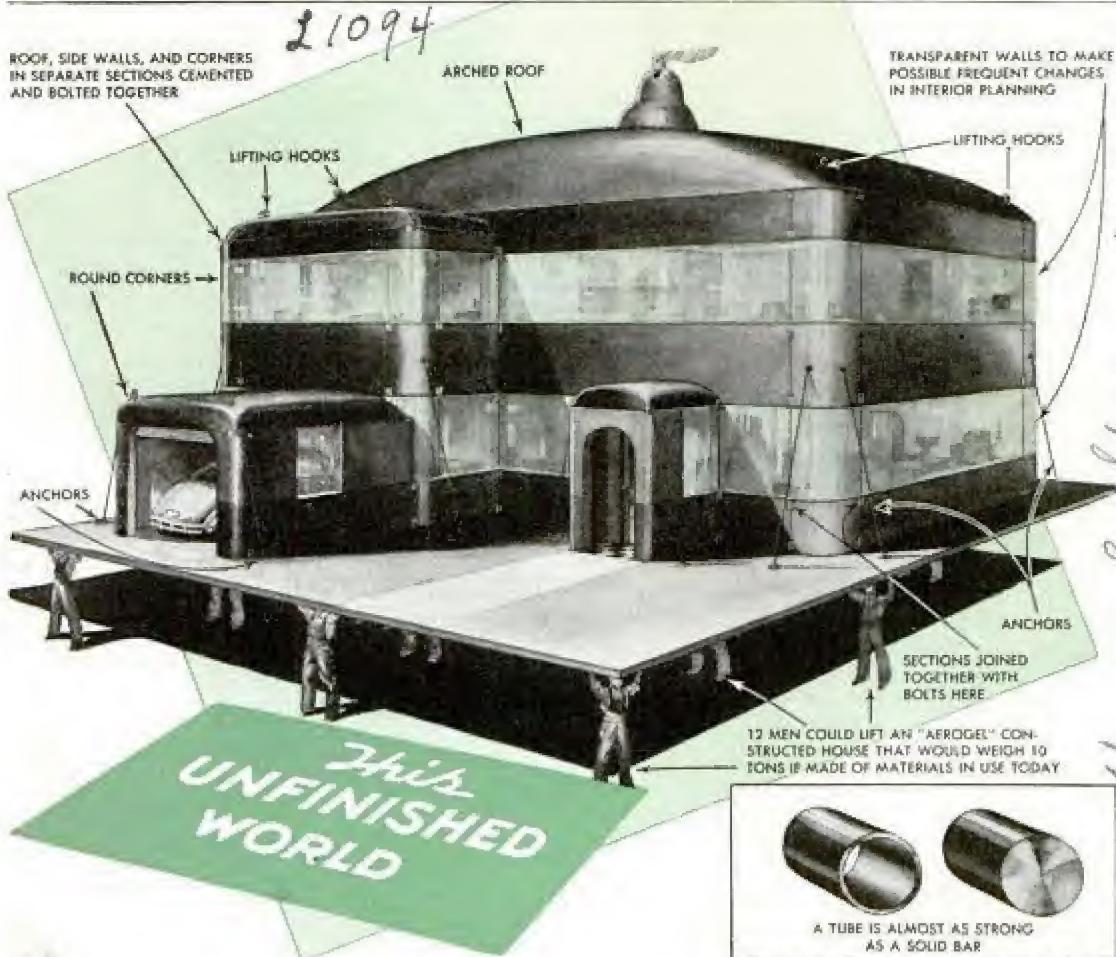
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WRITTEN SO YOU CAN UNDERSTAND IT

Vol. 77

JANUARY, 1942

No. 1



By Dr. R. M. Langer

Research Physicist, The California Institute of Technology

Pasadena, California

WHAT are we going to do when the war is over? For years people have been complaining that there are no more opportunities. Unless things as important as the automobile and radio occur to take up the slack in employment, they say, civilization will be in the doldrums.

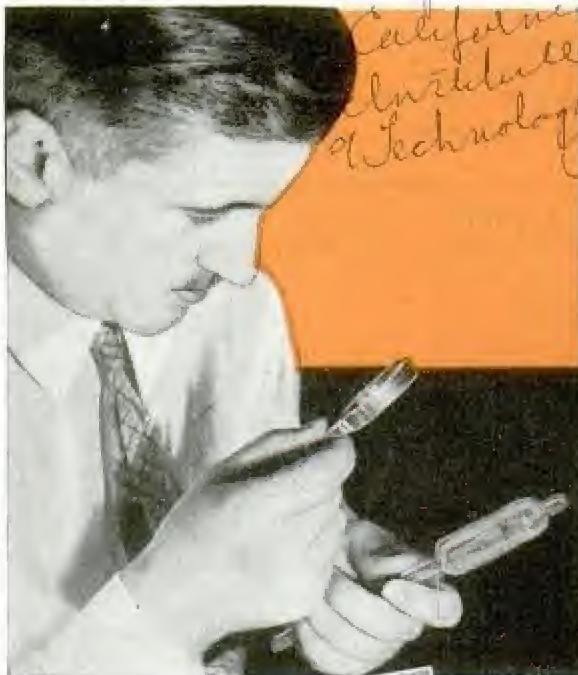
The fact is that a tremendous amount of work remains to be done. We have hardly left the period when life was a struggle for existence and are only now entering the period in which we should learn to live more fully. No opportunities left? There are so many staring at us that we are really behind schedule.

For one thing, there are improvements to be made in everything we have. It is surprising to see how



Since a tube is nearly as strong as a bar, cables stronger than girders of equal weight and bubbles almost as strong as grains, the author predicts that buildings of the future erected on these principles will be light as cork, yet quite substantial

Cont. Thomas E. Shorrock, Los Angeles
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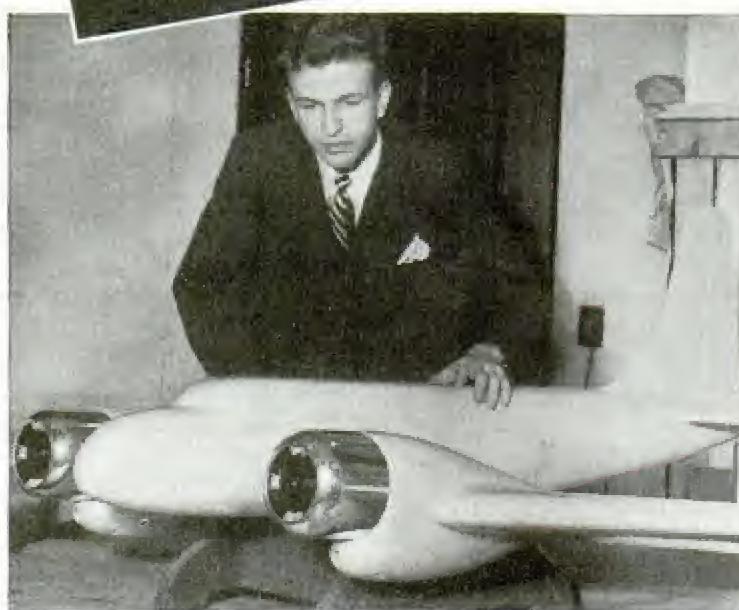


Top left, inspecting tiny radio transmitter complete with antenna, in glass vacuum tube

Top right, model channel in which erosion by water is studied

Center, a hollow electrical conductor—one way to save weight

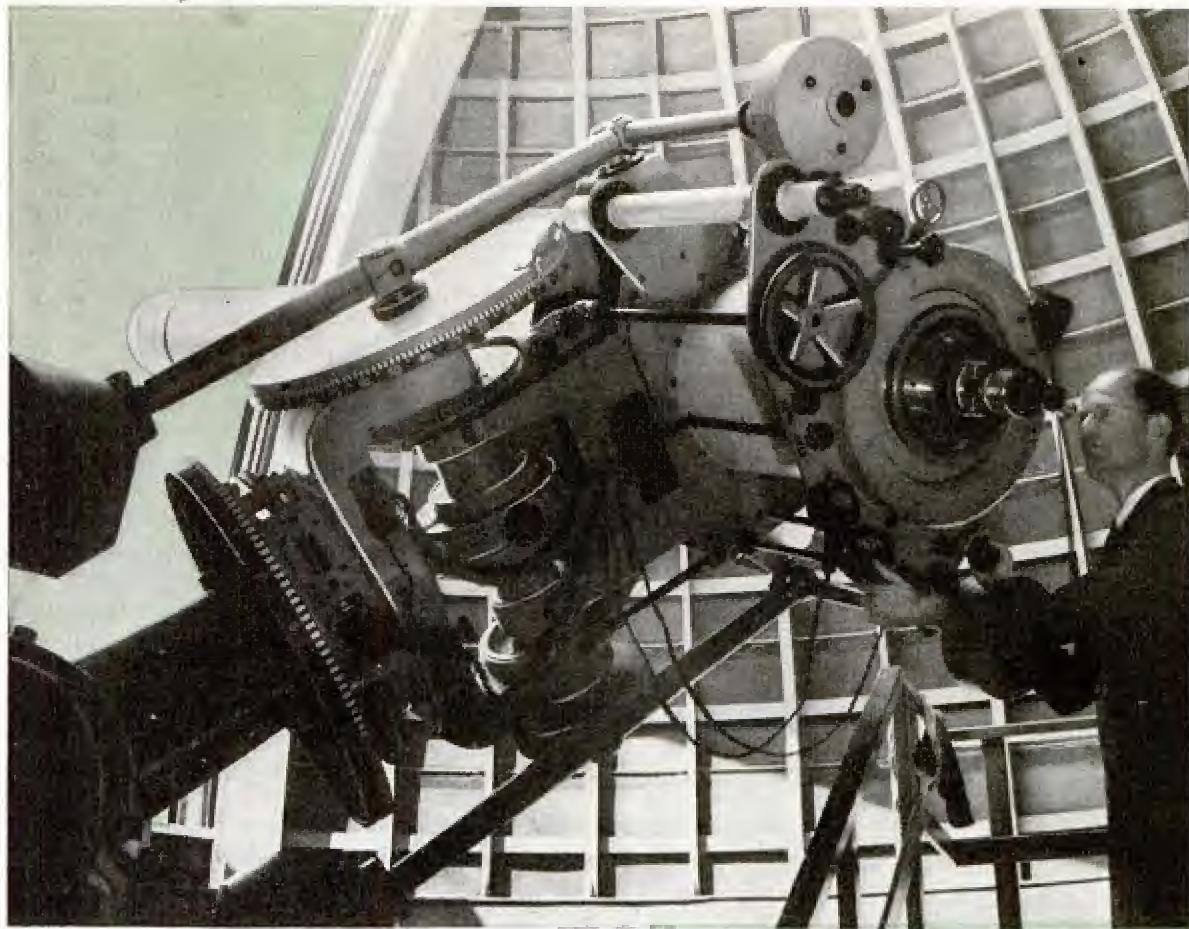
Models like the wind-tunnel bomber, below, are contributing to engineering knowledge



important a small improvement can be. Ordinary glass was good enough for hundreds of years, then a slight change in manufacture produced Pyrex. Suddenly civilization has a brand new substance, a glass suitable for cooking, for electric light globes, and for inexpensive radio tubes. It is fair to say that, as electric light globes, this development has granted each of us several extra years of reading and working time.

If you hold an ordinary glass tumbler in one hand and a Pyrex tumbler in the other, your body heat expands the ordinary glass only 1/100th of an inch and the Pyrex glass but a third as much. You can't possibly tell the difference, yet much of what we can do today was made possible by this property. Recently glass of an even smaller coefficient of expansion was produced. This is being used for the

21094



mirror of the 200-inch Mount Palomar telescope and is replacing Pyrex for many uses. Similar to the improvements in glass, slight changes in other materials are going to alter their characteristics and lead us into new paths.

We are still living in the Age of Weight. Civilization needs stronger, lighter materials. Our strongest materials today are much weaker than they should be, simply because of minute flaws. Hence we have to build bulky, unwieldy structures that load themselves down. Very fine wire of steel or tungsten is ten times stronger, for its size, than are huge girders of the same materials. The weakening flaws seem to be eliminated in the minute diameters. Thus, when we learn more about the nature of metals and how best to work with them we can expect to build lighter yet stronger structures. It isn't ridiculous to say that automobiles will weigh 300 pounds instead of one and a half tons. If the motor is reduced in weight, the chassis and everything else go down in proportion. Upkeep and fuel consumption also diminish,

Astronomical telescopes have their part in research that develops new products for civilization

Face mask containing short-wave radio electrodes is used for patients requiring radio treatments



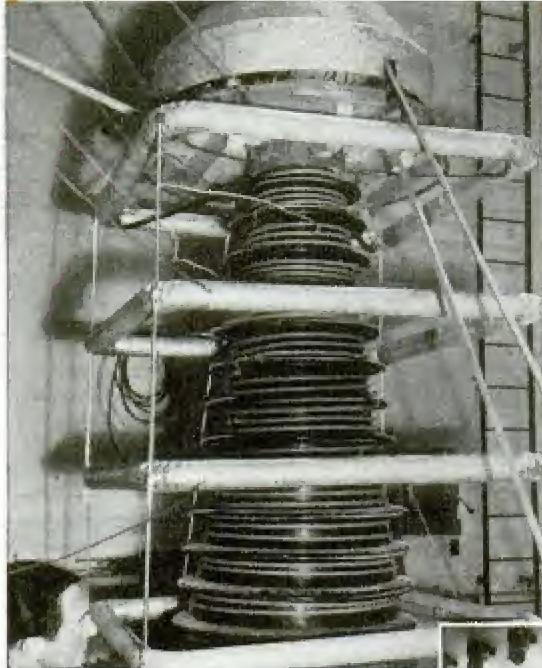
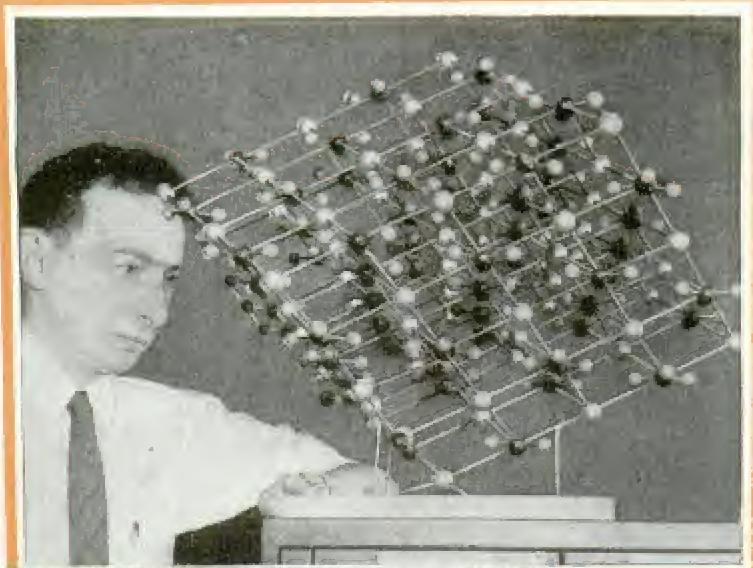
21004
← Model of structure of crystal

may allow us to do incredible things with super-lightweight materials. The starting point may be the "aerogel" compounds now used mainly as gas or moisture absorbers. These substances are composed of innumerable minute bubbles like foam, stuck together to form a solid mass. Some of them are 20 times lighter than water, 10 times lighter than cork. Ultimately we can hope to make them strong without increasing their weight. It may be that

some common cementing material will be the answer to this.

Imagine a house built of such bubbles instead of heavy brick, wood, glass, and plaster. Its cost would be little because there would be little material needed in the first place, and no heavy materials to transport and erect. Instead of expensive foundations, simple wind anchors would hold the house in place. The walls could be formed in place with a spray gun, and the roof arched over, integral with the walls. Our bubble house is automatically sound- and vermin-proof, insulated against extremes of temperature, and has no heavy

In this laboratory the effect of artificial fluorescent lighting on plants and parasites is studied



↑
**Alternating-current vacuum tube
with which the physicist can cre-
ate radio-active substances**

with the reduced horsepower required for the same performance. The railroads have already begun to use lightweight equipment.

We have hardly started to develop aluminum, magnesium, and the other light metals. In spite of their higher costs they can be cheaper than iron, once we take full advantage of their lightness. Similar research



21094

elements to collapse in an earthquake. It is fireproof. Part or all of the walls could be left transparent so that with draperies and shades you could arrange your windows to suit your convenience, and change them when you wish. With the chief use for cheap lumber eliminated, our forests would become parks and game preserves instead of useless cut-over land.

If this appears fantastic, remember that it is only because of tradition and the availability of materials to our ancestors that we have always built heavy, expensive homes. A tube is practically as strong as a solid bar, and a minute bubble is practically as strong as a solid grain. There you have the basis of lightness and strength.

You see, it is difficult to tell what changes a small development can make in our lives. The motion picture is nothing but a photographic trick, yet it turned out to be a great social force, changing our modes of dress and manners of living. The radio is only an electrical gadget but it is changing history. As a method of mass transportation the airplane has so far failed to live up to predictions, and yet what it has done to stimulate the development of light alloys and to revolutionize construction designs and techniques is of the utmost value to all fields of engineering.

The typewriter is often regarded as a simple labor saver and yet it has determined the style of our business letters and the quantity and quality of our literature. Its principle has been developed into tremendously complicated business machines that not only do our bookkeeping and solve intricate mathematical problems but that are becoming a means of keeping the nation united and conscious of its needs and desires. By means of such machines more frequent inventories of the population and its wishes may be polled. Rapid "sample" balloting and tabulating, now used to indicate trends of opinion, will blossom out into a control that will enable production of goods to keep in step with demand.

No one knows where our investigation of the energy spectrum will lead. In the short waves, work is being done with radio waves only an inch long. Tiny vacuum tubes have been built that contain an entire transmitting set, complete with all circuits and even an antenna inside. Call that a stunt, if you like, but consider the possibilities that are unfolded. It makes possi-

(Continued to page 194)

21063

Rigid Stretcher for Rescue Folds About Patient



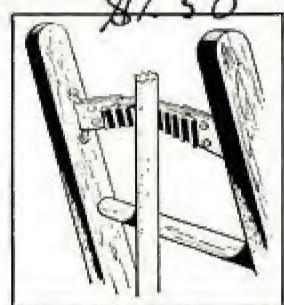
Stretcher guards injured person on way down ladder

Greater safety in handling injured persons is possible with a rigid type stretcher, invented recently, which immobilizes the body. The patient is strapped in with special straps that prevent movement of fractured limbs or a broken neck, and then the sides of the stretcher are folded about him. Since it can be carried vertically or tilted without disturbing the patient, the stretcher is easy to handle in close quarters, therefore valuable for rescue work.

21155

Ribbed-Rubber Grip on Ladder ✓ Holds It Safe Against Pole

To keep a ladder from slipping when rested against a pipe, pole or corner, there is a rugged grip of heavy leather which can be attached to any ladder top by its metal handles. At the center is a section of ribbed rubber composition which holds the ladder safely.



Joseph Luree, Worcester, Ohio

Close mpo G. 5
1100 Champa St.
Denver, Colo.

2/10 4 Cmt. Press Association, Inc.
60 Rockefeller Plaza
New York

Radio Reports Chutist's Pulse in Six-Mile Fall



→ Swaying and spinning as he plunged 29,300 feet before pulling rip cord, Mr. Starnes looked like a man from Mars. Notice movie camera on his hip

Here he is before the takeoff. Automatic radio transmitted his heartbeats to ground station and there was another transmitter in his helmet



Calumet City, Ill.

Parachute jumps are no novelty to Arthur H. Starnes. He's dropped 300 times. But dropping nearly six miles before pulling the ripcord is a rare event in any man's life, Mr. Starnes included. He did that the other day, laden with 115 pounds of equipment and instruments that recorded pulse, respiration, altitude, time and other factors of interest to science. Picking a day when it was clear enough to spot the field below with a telescope, Starnes bailed out over a Chicago airport from an altitude of 30,800 feet. As he plummeted to earth, his heartbeats—normal except for a slight increase just before he leaped and again as the first 'chute opened—were broadcast by radio to a receiving set on the ground and recorded on a wax disk. A recording pneumograph showed that he took six deep breaths, eight shallow ones. His goggles frosted over as he plunged through a cloud, cleared at about 5,000 feet. The altimeter that would tell him when to open the parachute was strapped to his wrist.

"I kept glancing at the altimeter," he related afterward, "then at objects that passed about me. I had a firm grip on the rip cord. I watched the needle go by the 2,500-foot mark. I seemed to be falling face foremost once more, rocking and wobbling. I was very much alert. My mind

was clear, my sight good. Then I started to spin again. I shot my legs out and spread them, glanced at the altimeter and pulled the rip cord as the needle passed the 1,500-foot elevation mark. I felt the pack burst open. There was a short lapse, then a terrific jerk. I looked up. The 28-foot chute was open."

An automatic stopwatch timed the free fall at 116½ seconds. He had averaged 170 miles an hour, dropping from a level where the temperature was 46 degrees below zero and air pressure four pounds to the square inch, to a ground temperature of 60 degrees above zero and atmosphere of 14.7 pounds pressure. A barograph traced the story of the fall in altitudes and a motor-driven motion picture camera showed his gyrations in the air. His flying suit was electrically heated, and an oxygen bottle was

21054

connected to his helmet. There was a radio speaker in the helmet for talking to his ground crew.

Mr. Starnes pointed out the military lesson of his fall, that a properly equipped aviator can drop from tremendous altitudes without losing consciousness or freezing, and that a free fall decreases the likelihood of the pilot being struck by his own falling plane or parts, or being shot by an enemy. Further, there is less danger of damage to the parachute, since the velocity of a free-falling object increases or decreases to a stable rate of about 120 miles an hour, while the speed of the plane at the moment of the leap might be 300 or 400 miles an hour.

21141

Hand Tool Dresses Grinder and Keeps Wheel in Balance

G. dynamore.120
Titanium Dresser
Grinding wheels can be kept true, sharp and in balance with the aid of a hand-held dresser which itself resembles a miniature grinding wheel. Held against the spinning grinder, the tool, said to have a cutting edge almost equal to that of a diamond, dresses away ridges, grooves and out-of-roundness. Sides of the grinder which become uneven can also be trued.



Frequent use of this dresser keeps grinder true

Giant Windmill on a Mountain ✓ Delivers Electric Power



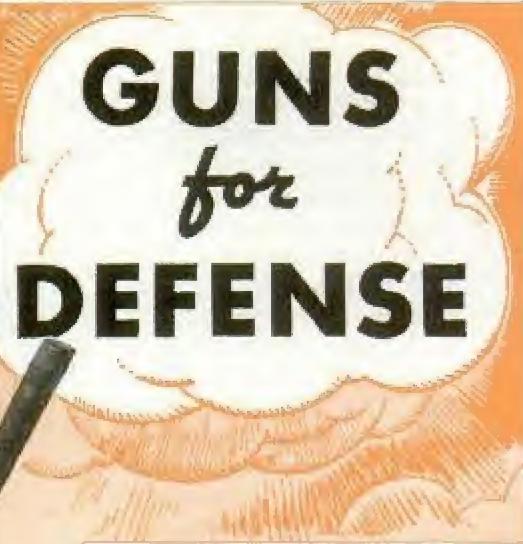
Wind power will be converted into electricity when windmill is completed

Nearing completion atop a 2,000-foot mountain—on Grandpa's Knob, near Castleton, Vt.,—is a \$500,000 windmill embodying the latest serious effort to generate commercially useful electric power from the wind. It is expected that the blade will rotate fast enough to produce electricity in winds of about 18 miles an hour. Invented by Palmer Cosslett Putnam, of Boston, Mass., the wind turbine will have two huge blades of stainless steel, each weighing 20 tons, mounted on a pintle girder which also will support the alternating current generator. The tower is 110 feet high.

Ref: G. Morgan Smith & York, Va

21/05

Leroyth



Your Uncle Sam got off to a bit of a late start, but with a gigantic effort has transformed the nation rapidly into a vast arsenal turning out the biggest and best guns that engineers of the armed forces could conceive and American industry could manufacture. At the top, "C" battery of the 5th Field Artillery grooms its 155-millimeter field pieces for the First Army war games. At the left, the first 90-millimeter antiaircraft gun mount produced by private industry is turned over to the army at LaPorte, Ind. The huge coast-defense rifle, below, was towed to Fort Church from Tiverton, R. I., to guard our Atlantic approaches. Weighing nearly 145 tons, and stretching 68 feet long, its two miles an hour ride was cushioned on 38 pneumatic tires of a tractor and double trailer combination. These air cushions saved the highway from damage by the tremendous load.



L1105.



Flame and smoke belch from the mouth of one of the U. S. Army's 14-inch railway guns at Naples, Calif., as a pair of these Goliaths start target practice. The first is always a "settling" shot to pack the earth in the embankments to insure accuracy in subsequent firing. These guns are flinging 1,400-pound projectiles seaward over a target range that averages twenty miles

United States Military Academy cadets at West Point are kept up to date in the use of the army's newest artillery equipment. At right, an instructor helps them master the highly complex mechanism of a three-inch antiaircraft weapon



U. S. Army Signal Corps photo

This is one of the army's 37-millimeter antitank guns on a mount with a short wheel base capable of maneuvering into position rapidly

L 1105



U. S. Army Signal Corps photo

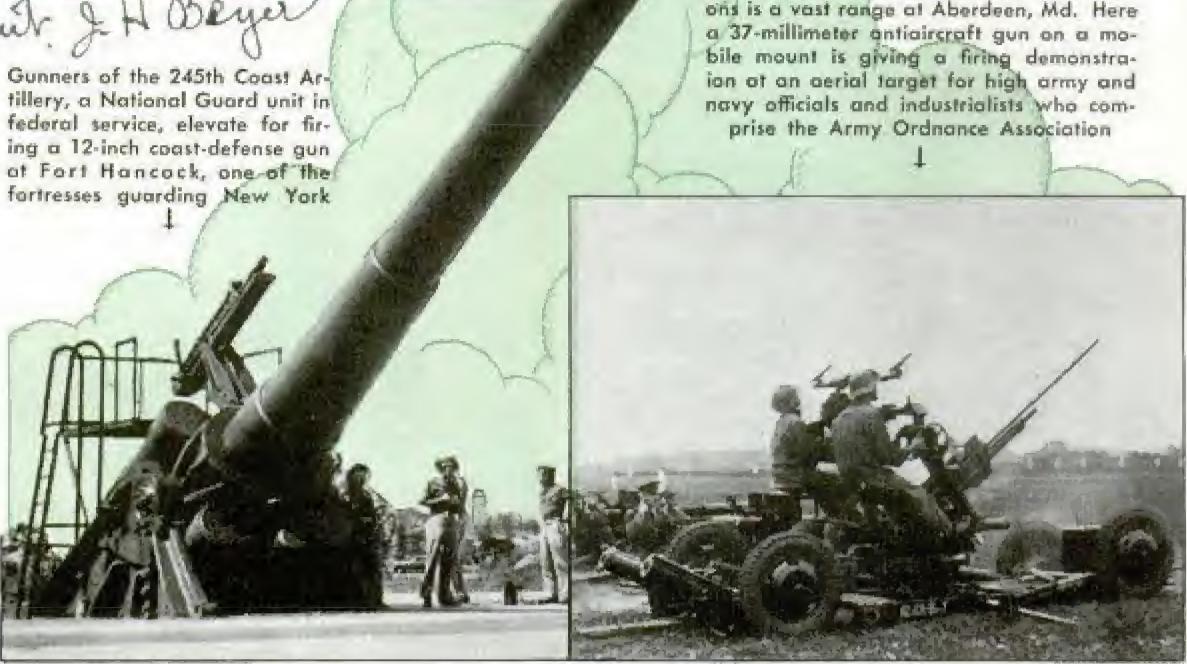


In battle dress during maneuvers in the field, the four-man crew of a 37-millimeter antitank gun takes a sight on the target



Lieut. J. H. Beyer

Gunners of the 245th Coast Artillery, a National Guard unit in federal service, elevate for firing a 12-inch coast-defense gun at Fort Hancock, one of the fortresses guarding New York

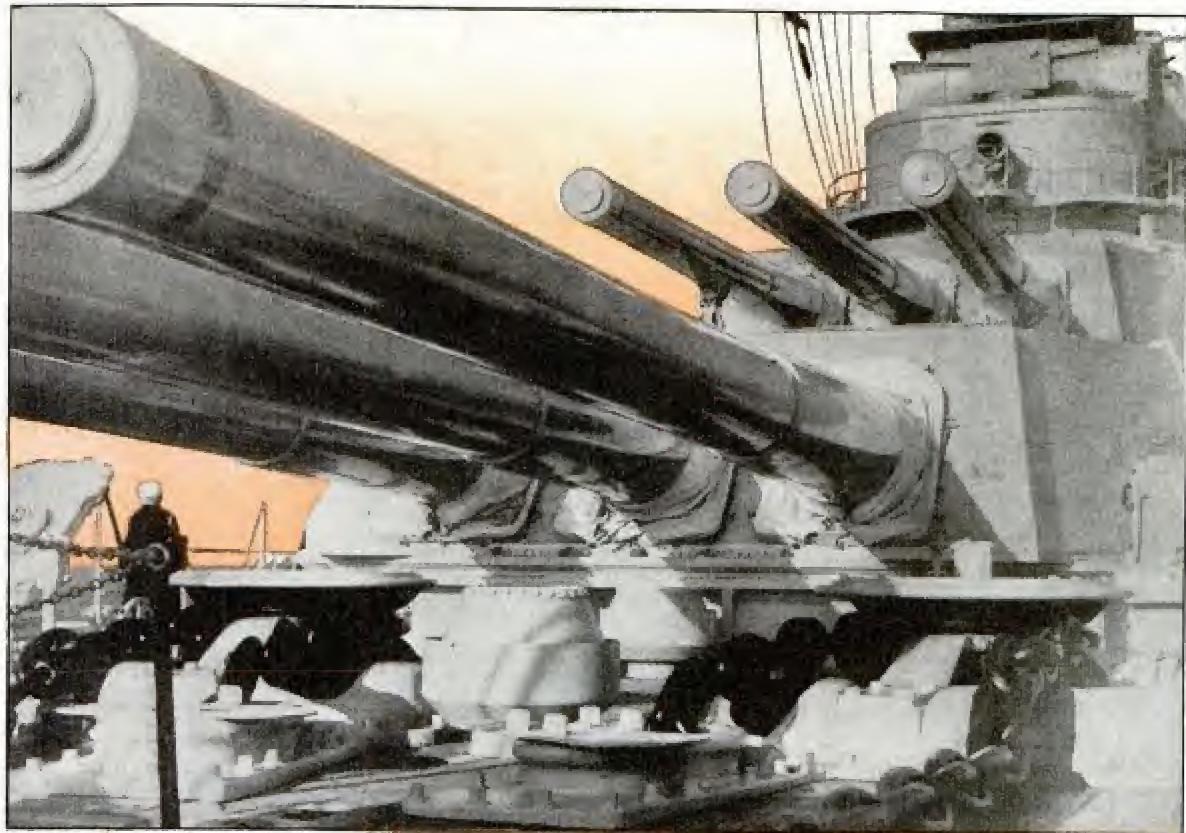


Manufacturers find themselves doing strange jobs in these times. As an example, one company which normally turns out huge bread-making machinery took on as an emergency assignment the building of the 60-millimeter trench mortars shown at the left. Here two lieutenants are adjusting angle of fire of weapons under test at York, Pa.

Proving ground for the U. S. Army's weapons is a vast range at Aberdeen, Md. Here a 37-millimeter antiaircraft gun on a mobile mount is giving a firing demonstration at an aerial target for high army and navy officials and industrialists who comprise the Army Ordnance Association



21105



Official U. S. Navy photo

↑ The battleship California dates from 1919, but it's still able to talk persuasively for the U. S. Fleet with these six 14-inch guns of 50 caliber, which form the forward main battery

Official U. S. Navy photo

Three sailors team →
up to clean a
cruiser's gun



The yawning monster at left is one of the 16-inch guns of Battery Harris at Fort Tilden, N. Y., which have been practicing their aim at offshore targets recently. These guns can throw a shell weighing more than a ton at a target 18 feet square 30,000 yards distant. Each gun can be fired once every 90 seconds and it costs Uncle Sam \$3,000 for every shot fired

L1130.

Twenty-Ton Aerial Troopship Carries 36 Men



drnk.

Twenty-ton troop transport plane, converted from passenger ship, has facilities to carry 36 soldiers

Thirty-six passengers and 5,000 pounds of baggage can be carried by the Army Air Forces' new troop transport plane, which was designed originally by the Curtiss-

Wright Corporation for commercial purposes. The 20-ton ship, powered by two 1,700-horsepower Cyclone engines, is manned by a crew of five.

L1162.

Metal "Spats" Dress Up Car Like White Sidewall Tires

✓ White sidewall tires are gone for the duration of the emergency, but now you can dress the car up in "spats." Whiter

than the sidewall tires—for they're easier to keep clean—the "spats" are of metal. They will not scuff against curbs, and since the trim does not extend beyond the edge of the rim it has no effect if a tire goes flat.

L1165

"Economizer" Enzyme in Body Is Clue to Cause of Cancer

Scientists are studying an "economizer" enzyme in the human body for a solution to some of the riddles of cancer. This enzyme, which helps prevent the squandering of food reserves, has been named the Pasteur enzyme in honor of Louis Pasteur, French scientist who discovered the power of oxygen to check fermentation processes and protect food stores in the body from needless destruction. It is the Pasteur enzyme which keeps oxygen at this task. Without it, food in the body would be burned so rapidly that an adult would have to consume more than 10 loaves of bread daily to get enough energy for living. It is believed that there is a shortage of the Pasteur enzyme in cancer cells.

C. B. Arke - E. C. Beach



White metal "spats" dress car like white wall tires

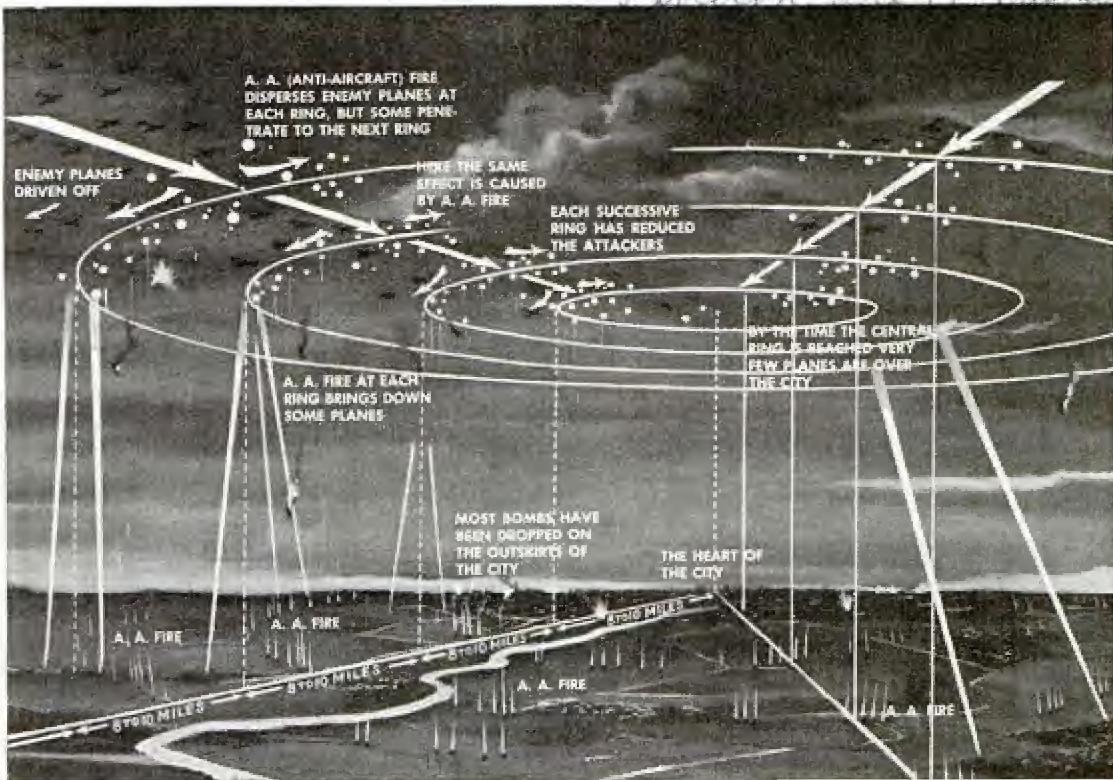
12 General Tire &
Rubber Co., Akron, Ohio

Ref. Dr. Kurt L. Stern
Yale University School

POPULAR MECHANICS

L1166
of medicine, New Haven, Conn.

21146 London Electrolyte Agency, Ltd.
134 Fleet St.
Rings of Fire Guard City From Aerial Attack
London E.C.4, England



This drawing shows the plan adopted by Moscow for air defense, forcing bombers to fly through rings of fire

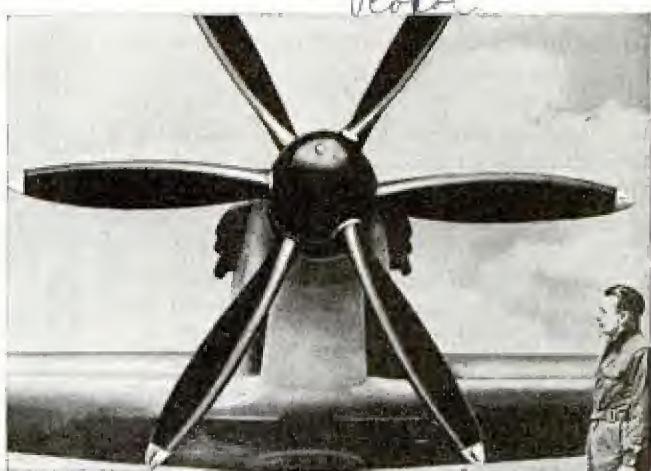
One of the most effective schemes for guarding a city from enemy bombers was that employed at Moscow, where concentric rings of antiaircraft batteries and searchlights filtered out the attackers before they could reach the heart of the city. The guns were carefully concealed, and ten or twelve of these circles of fire surrounded the capital, the outer ring more

than 40 miles distant from the center of the metropolis. Each ring would drive off or shoot down part of the attacking force, and of perhaps 200 planes participating in a raid only a few would pierce the defenses. The multiple barrage of antiaircraft fire, barrage balloons and fighter planes combined to disperse or spoil the effective aim of the invading bombers.

Twin Three-Blade Propellers Turn in Opposite Directions

Improved handling of an airplane during acrobatics and elimination of torque reaction are claimed for a double set of three-bladed propellers mounted together. They give the appearance of a single six-blade propeller, but actually there are two which rotate in opposite directions.

This looks like a six-bladed propeller, but in reality there are two units, each having three blades and revolving in opposite directions. It is claimed to eliminate torque reaction present in one-way propellers and aids in handling the airplane.



British Empire Photos, Ltd.
271 Madison Ave
New York City

City College, New York



Dr. Joseph Barmack takes blood pressure of subject in circulatory efficiency test

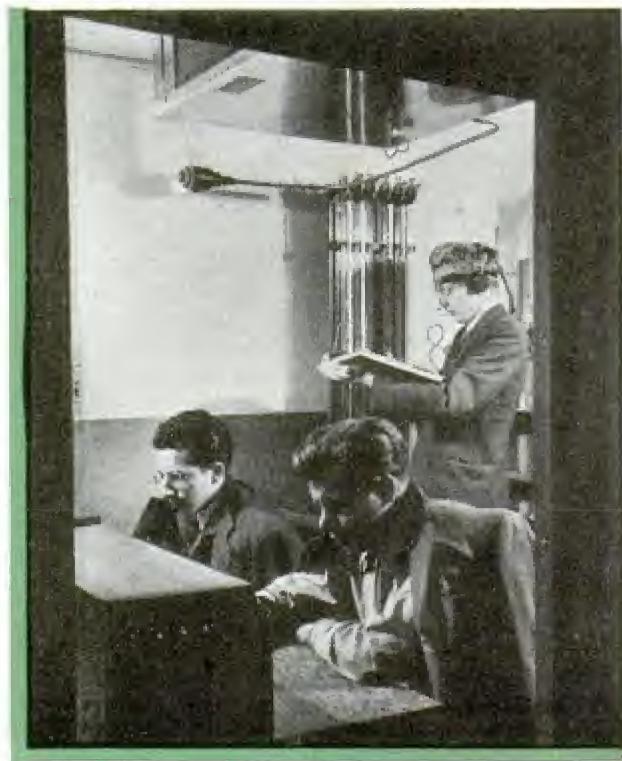


Foot controls linked to work show restlessness of subject in the test chamber

TESTS to determine whether certain drugs can be used to counteract "detrimental effects" produced on aviators flying at high altitudes have been undertaken by the City College psychology department at New York. The tests were prompted by the discovery of Army and Navy medical corps that the low oxygen content in the air, the freezing temperature, poor ventilation, noise and boredom with which flying pilots are confronted frequently, cause emotional and muscular disturbances "similar to those induced by drunkenness" and result in errors of judgment that lead to accidents. The study will be conducted for about six months, testing fifty subjects, students and teachers. They are placed in a special chamber for three hours at a time, asked to perform simple tests and their reactions carefully studied.

The test chamber can be made to produce rapid changes in temperature and varying oxygen content of the air to create conditions similar to those at 12,000 feet above sea level. This height, it is said, is at the threshold of the most troublesome altitudes. The chamber resembles a refrigerator of the type seen in butcher shops. It is 7 feet square and 10 feet high, insu-

Subjects in chamber in position pilot would assume; checking results is a third man



L 1467

FLIERS

lated by three inches of cork and containing triple plate glass windows for observation. The subject enters through a huge, heavy oak door, containing an "air lock" through which samples of the air within can be passed outside. The work is under the supervision of Dr. Gardner Murphy, chairman of the Psychology Department, and Dr. Joseph Barmack, head of the psychosomatic laboratories at the college. Secrecy shrouds the survey, due to the effect which positive results would have on military flying, which seems to be going higher and higher. Fighting at 40,000 to 50,000 feet may not be uncommon in the near future.

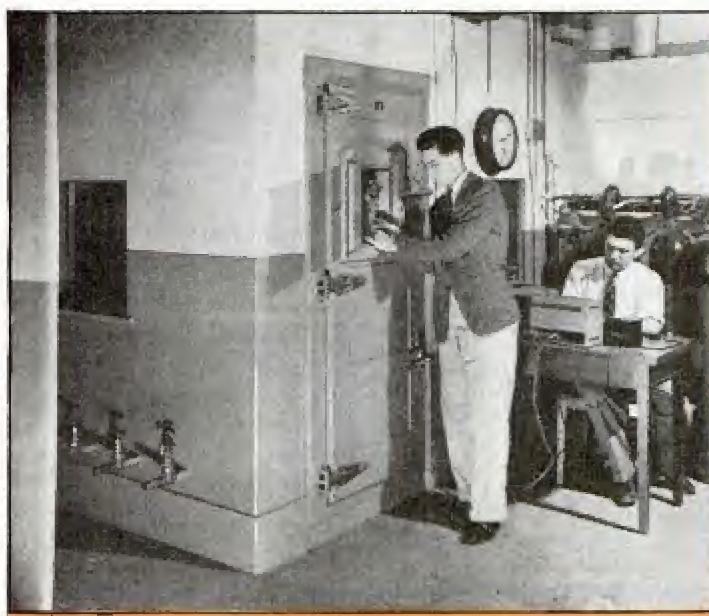
City College, New York

Removing sample of air from chamber for analysis. Dr. Barmack (seated) checks reaction of subjects



Dials tell Dr. Barmack how subjects (seen through observation window) are doing in chamber

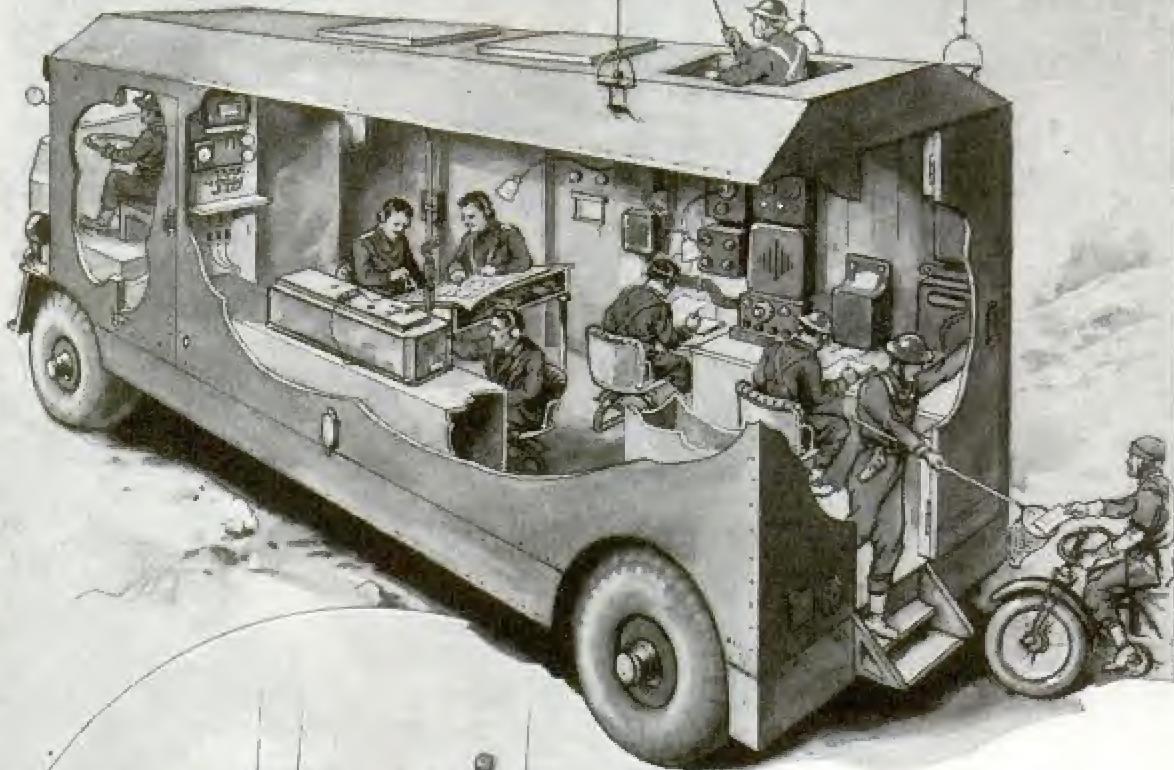
Pointer shows subject's reaction; if drug helps him, he responds readily throughout the test



2995 London Electrotype Agency, Ltd

Mobile Headquarters Directs Tanks by Radio

✓ 23-24 Fleet Street
London England



"Halt!" Through the skylight of the armored command car a signal is raised to flag down a heavy tank rapidly approaching from the rear. The commander of the brigade then leaves his mobile headquarters and transfers to the tank, which carries him to a forward position from which he can transmit further orders to the brigade by radio. This command car, called the "Dorchester," was sketched during British army maneuvers.

To achieve close coordination of the attacking forces in the fast tempo of modern "panzer" warfare the British army has developed a mobile headquarters car, a 12-ton armored vehicle housing the brigade commander and his staff. From this office on wheels the maneuvers of a fast tank division are directed. In the cutaway view above, the Brigadier can be seen at the central control desk beside his Major; at the left center is the brigade radio operator; on the right is a signal officer at an "interception" radio set and another operator at the "house" telephone set. From the roof a soldier manipulates a signaling disk to call a scout car, tank or dispatch rider. At the rear of the car one of these riders, without stopping, drops a message into the "landing net" held by an intelligence operator. At the back of the driver's cab there is space on the wall for large sectional maps of the territory where the battle or maneuvers are taking place.

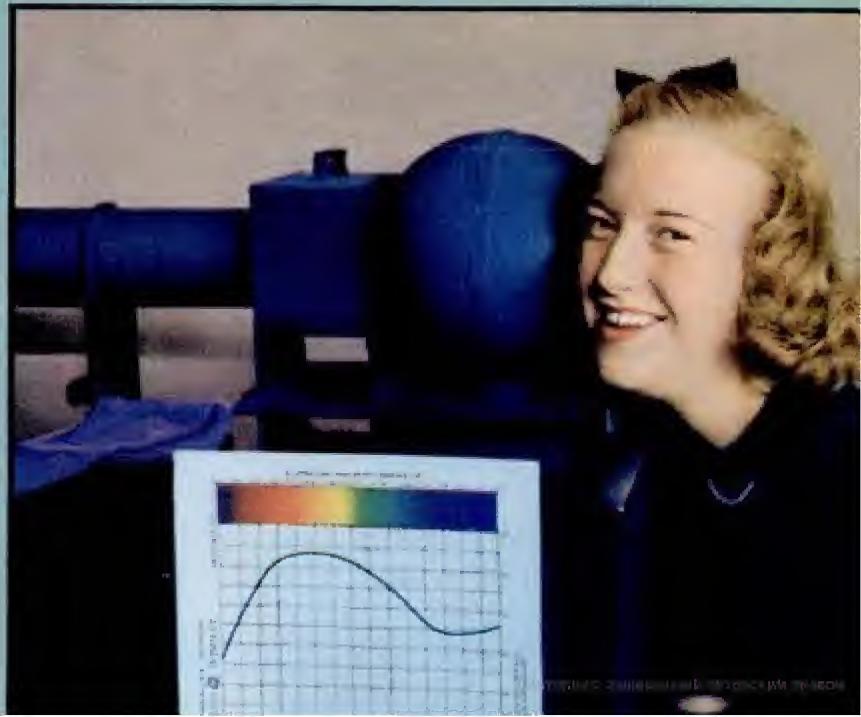


17 2938

SECRETS of COLOR

In general, women prefer red and here an artist reproduces on his palette the color of the model's gown. This is a natural color picture from the General Electric movie "Curves of Color"

Only a machine can measure the delicate tints of a blush. Note the color analysis chart with the curved line—the scientist's way of showing the exact degree of color produced when the girl blushes





18
J. L. Michelson of General Electric Co. preparing to record girls' blushes on color-analyzing machine, the recording photoelectric spectrophotometer. Many companies are using this machine

2938

see Colorado March 1942

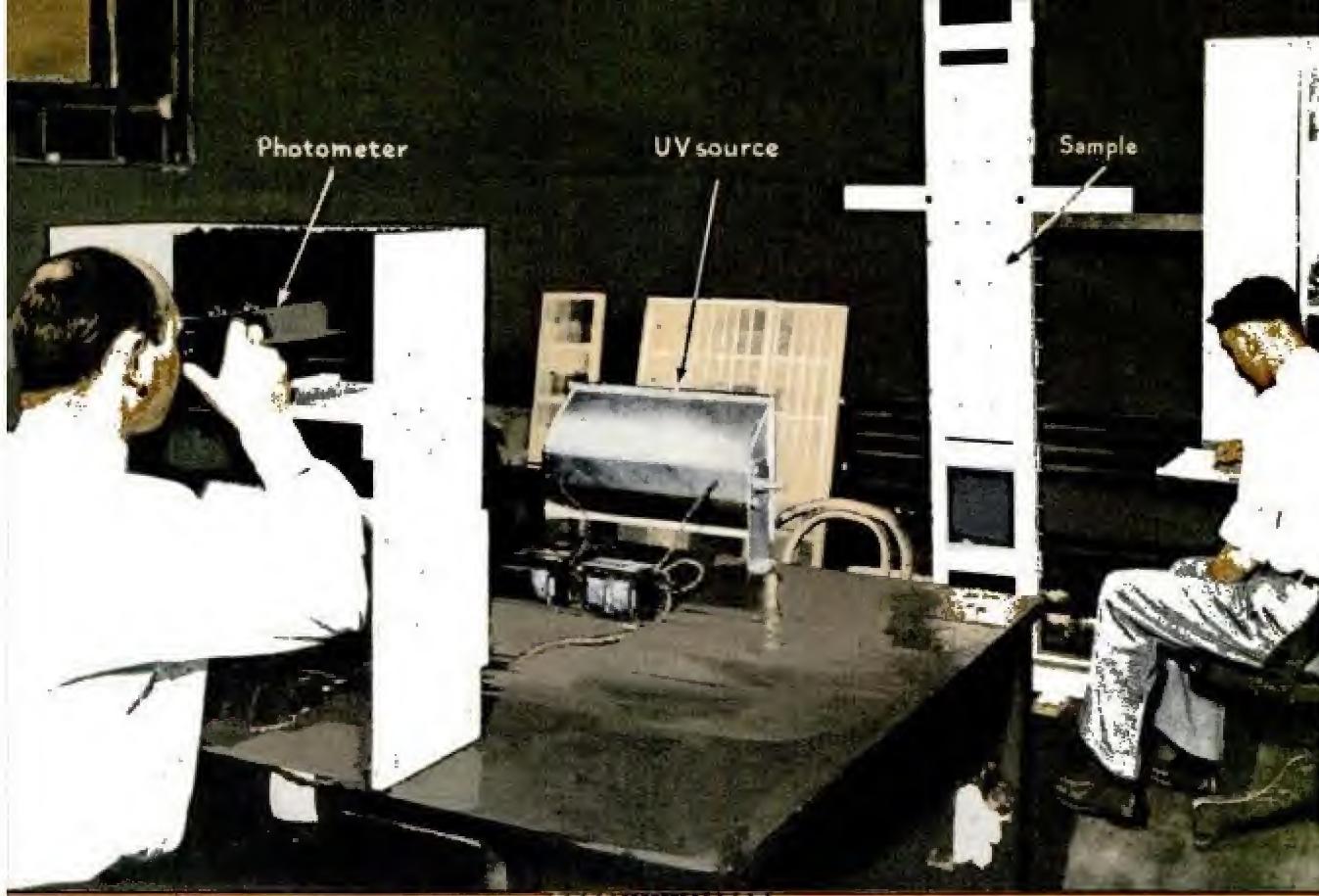
By Julian Leggett

HOW red is the rose, how "blue" the violet, how "rosy" a maiden's blush? Not even an expert can tell you because no one's eyes can measure hues, shades and tints accurately. But a machine does the job with amazing precision and speed, enabling its operators to determine the exact percentage of color in any object placed before its eyepiece.

Capable of distinguishing accurately more than 2,000,000 colors—the best-trained human eye recognizes only a fraction of that number—the machine is the recording photoelectric spectrophotometer. It is just coming into use as an invaluable aid to manufacturers of paints, color inks, paper and other products where color is of paramount importance.

This new scientific instrument settles, to its own satisfaction, at least, the argument about the difference between a blonde and a brunette. Instead of deciding which is preferred by gentlemen, it draws curves on two charts which are identical save for a slight shading characteristic of the dark-haired girl. The operators interpret the curves to mean that the difference is only skin-deep; the brunette's skin contains a small amount of dark pigment, or coloring matter, which her fair-haired rival lacks.

Here is how the instrument works: the sample to be studied is placed in front of the eyepiece and scanned in rotation by every color in the spectrum, from deepest violet to deepest red. The proportion of every color reflected from or transmitted



19 | H. A. Breeding

by the sample falls on a phototube—"electric eye." The electric current produced is amplified to operate a motor that moves a pen across a paper or chart, resulting in a curving line on the cross-section chart. This is a quantitative color analysis. Two samples, which produce identical records, will match perfectly when viewed under any lighting condition.

With this color analyzer which greatly reduces the time consumed by scientists, new advances are being made into the mysterious realm of color, and many problems are being solved. Among the benefits already apparent are these: data can be obtained making possible the production at any time of new colors with predetermined characteristics, thus more uniform, high-quality products; pigments and pigment carriers can be mixed in such proportions that any colors can be matched exactly; colors can be standardized so

2938
Engineers making brightness observations on fluorescent paints in GE laboratory at Schenectady. UV source is a mercury lamp producing ultraviolet radiations. Below, "heart" of the spectrophotometer is this tube



2938



Here is a color demonstration box that is easy to make. Note two compartments formed by inserting white sheet of blotting paper in middle of box. Star-shaped hole is cut in the sheet. Then colored lamps of various hues are installed, with switches to control them separately. Observation hole is cut in forward wall of front compartment. The box provides a means of mixing color illumination for home experiments

↓

10



† Try this one: put red glass over one eye, blue over the other. Then look through them at same time and see whether the color is a mixture of the two. This illustration is suggested by "Color and Colors," by Dr. Matthew Luckiesh

General Electric Co. Lamp
Dept., Nela Park, Cleveland, Ohio

One of the most spectacular demonstrations of color lighting is this color fountain at Nela Park, Cleveland. As the water rises, it is illuminated by colored lamps, ever changing, located beneath the surface

↓



1938

that a purchaser may get exactly what he specifies, and basic materials used in any color mixture can be identified accurately, resulting in substantial savings for manufacturers and consumers.

For centuries science has studied the fascinating subject of color. Without light, either from the sun or from some artificial source, there would be no color—everything would appear black, as on a dark night. Therefore, color might be defined as a material which selectively absorbs radiant energy—light—and which reflects various wavelengths of light which it does not absorb. The material then appears to be the color of the wavelengths which it has reflected; thus colors are created in man's consciousness and are sensations, just as light is.

If the radiant energy of the noonday sun, which appears white, falls upon mercury sulphide—a chemical compound—light of certain wavelengths is partially or totally absorbed and the remaining energy is reflected by the substance. Upon reaching the eye, certain physical and chemical reactions

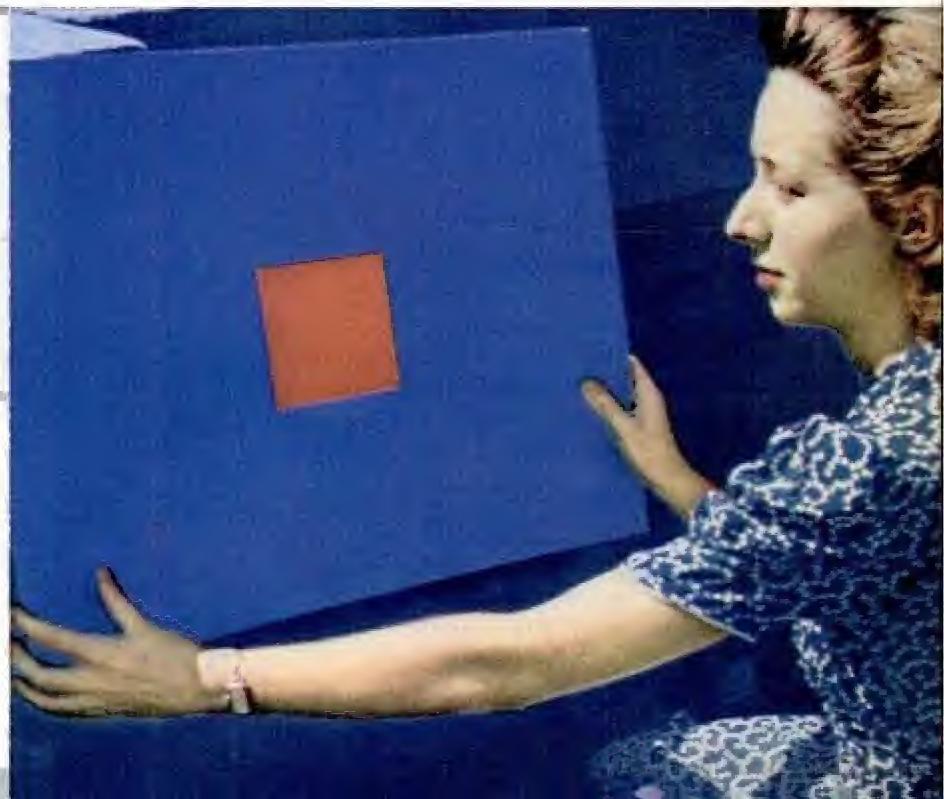


† Classifying colored fabrics with the aid of color analysis records made by the spectrophotometer. This machine renders valuable help in matching colors

Bottom of page, left, look steadily at black spot surrounded by colored spots while counting 30 slowly, then at the spot below. The result is startling.

(From "Color in Use" © International Printing Ink Corp.)

Hold large blue cardboard, on which is two-inch square of red, at arm's length in medium-lighted room. Then rotate it slowly. After several moments the red square should seem to dance and to lag behind.





Putting powder in GE Mazda fluorescent lamps at Nela Park. Fluorescent lamps provide an efficient source of color lighting, as well as of white light somewhat similar to daylight

take place, all in a fraction of a second, starting impulses to the brain which finally cause a sensation of red and we see the substance as a gorgeous scarlet.

Men prefer blue, while women's favorite is red, but science finds it difficult to assign a reason. Possibly, some say, it's because women, being more emotional, like the exciting, stimulating effect that red has on the senses, while men like the cheering, but subduing influence of blue. But you can't combine red and blue; together they exert a highly disturbing influence particularly in a room decorated predominantly in the two colors. You may prove this by taking a twelve-inch square of blue card-

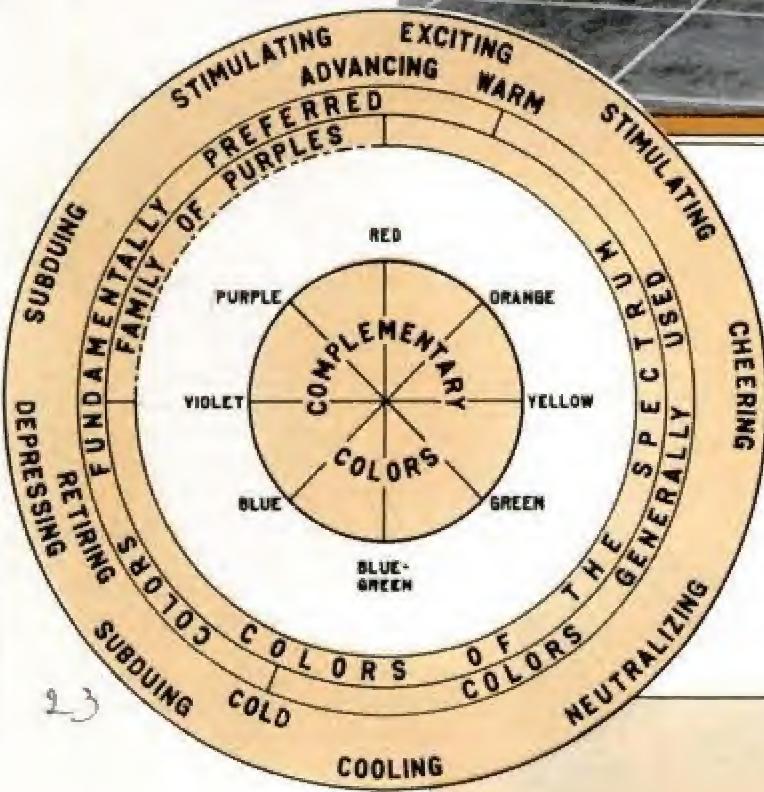
board and attaching to it a two-inch square of red at the center. Then, in a medium-lighted room, hold it at arm's length and revolve it vertically with a slow movement while looking at the red square. Soon the red square begins to dance before your eyes, making it difficult to distinguish the demarcations between red and blue.

A survey of light from the sun or from a tungsten filament electric lamp reveals four distinctly different or purely primary colors—red, yellow, green and blue. If the light is passed through a refracting prism, the eye sees a continuous band of color ranging from deep violet to deep red. The light has been separated by the prism into

It's E. Illumination
Laboratory
Schenectady

Squares on the floor are used to help measure amount of light emanating from fluorescent floodlight. Measuring instruments are placed over each square and the light reflected from the floodlight is recorded

2938



† This Color Circle, from "Color and Colors" by Matthew Luckiesh, D. Van Nostrand Co., New York, shows the general effects of colors as determined by research

Battery of six underwater →
floodlight reflectors and jets
which create the watery
plumes of color fountain at
Nela Park. The uplifted units
resemble tolling bells



its various wavelengths or frequencies. Careful measurements show there are at least 125 different hues distinguishable in the visible spectrum of light. To the four primary colors, black and white may be added because they are definite sensations, the first coming from a substance that absorbs all light wavelengths and reflects none, the second from a substance that absorbs none and reflects all. Thus, the greatest contrast between colors is that between black and white. In the



R928

† Cut a star-shaped hole in colored paper, then hold it against a white background. Soon the star will appear fringed with a color different from that of the paper

With light equal in intensity from a lamp and from the sun entering the room, a pencil held in certain position casts blue shadow on one side, yellow on the other

↓



24

United States, black is the mourning color; in China, white is used for the same purpose.

Colors change, according to Dr. Matthew Luckiesh, director of Lighting Research Laboratory, General Electric Lamp Department, Nela Park, Cleveland, and author of "Color and Colors," responding to the lighting and also to their surroundings. White paper on a green background, for instance, appears tinged with delicate pink or purple, but on a scarlet background, it appears greenish white. Similarly, if you cut a star-shaped hole in a sheet of colored paper and view a white surface through the hole, the star, instead of appearing white, will be tinged slightly with a hue complementary to the color or surrounding it.

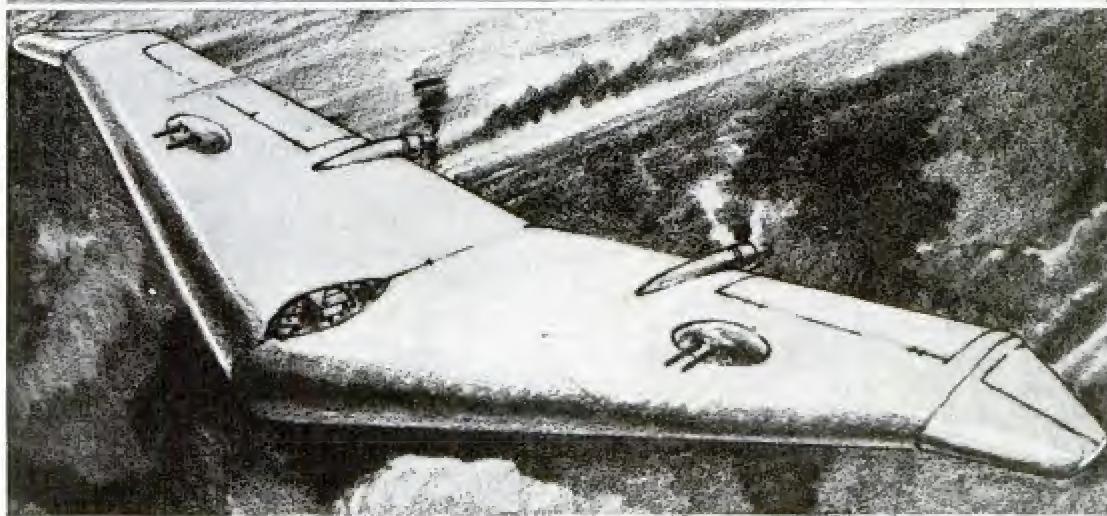
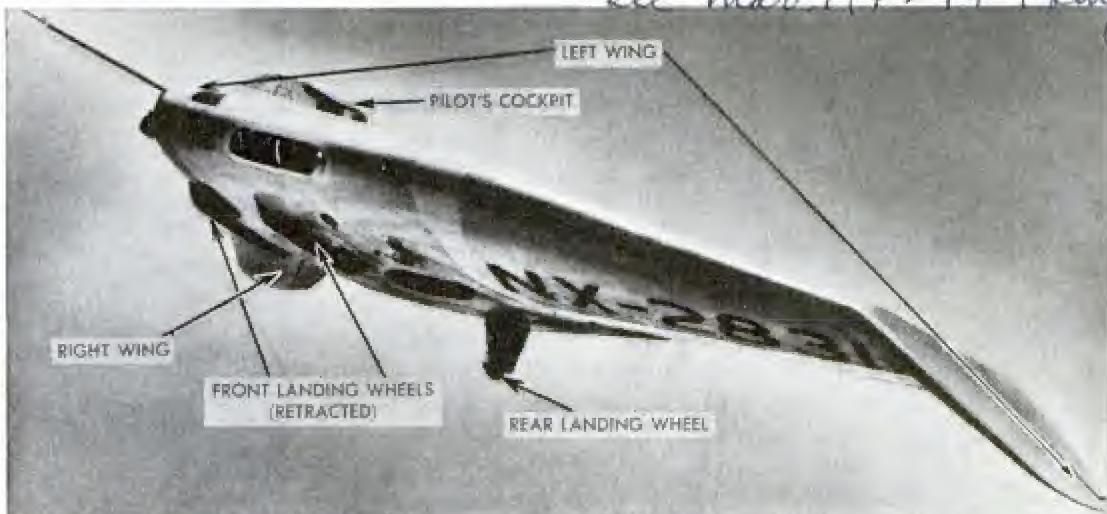
Rivalry between the retinas of the eyes is another interesting phenomenon, Dr. Luckiesh points out. If a red piece of glass is placed in front of one eye and a blue piece in front of the other, the white surface

(Continued to page 176)

L11.79.

Two-Motored "Flying Wing" Has No Fuselage

See Mar. 1942 14 (Long)



Long
Details of batlike plane remain a secret, but photo and sketch reveal some of its striking features

Consisting of a thick triangular wing, with no tail and no fuselage, a revolutionary airplane has been completed and test-flown in secrecy by Northrop Aircraft, Inc., under the watchful eyes of the United States Army Air Forces. Lack of maneuverability, the bugbear of previous "flying wings," is overcome with a sharp downward tilt of the wing tips that apparently include rudders and ailerons. What seem to be elevators nestle in the trailing edge of the massive wing. It also encloses two flat liquid-cooled engines, each driving a four-bladed pusher-type propeller. The cockpit is located on top near the foremost point. For war purposes guns will probably point from blisterlike turrets on the wing's upper surface. Because of the increased "lift" gained by using nearly every

square inch of its surface, and the virtual elimination of drag, the plane is expected to fly faster than many pursuit ships.

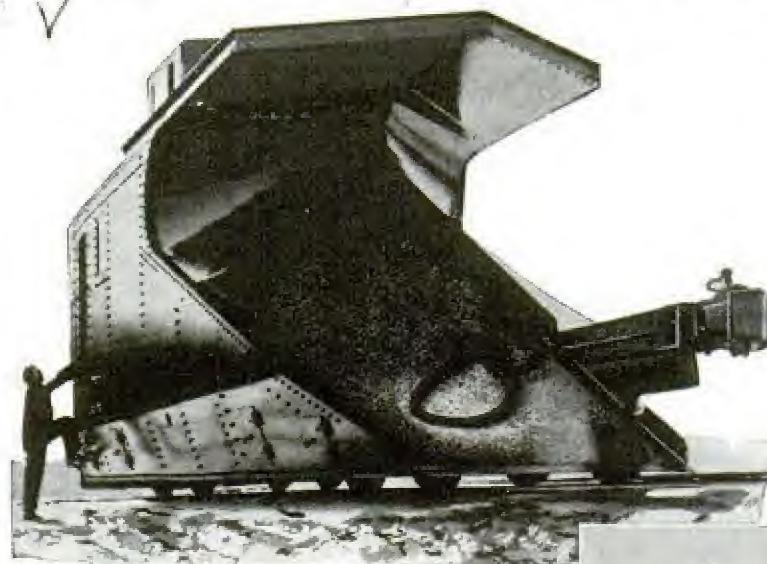
1041

Two-Ray Radio Tours Streets To Regulate Transit Lines

Cars equipped with frequency-modulation radio will play an important part in keeping the Cleveland Railway Company's transit system running efficiently. Ten such units, each carrying a 25-watt two-way radio supplied by General Electric, are used to patrol the city's lines, reporting on traffic conditions to headquarters where there is a 250-watt transmitting station. Whenever fires or other troubles impede traffic, the radio cars will render valuable assistance in rerouting the transit vehicles.

2004 Cmt. Earle W. Grage, Asheville, N.C.

Titanic Plows Clear Snow From Railroads



Plain wedge type plow,
easy to maneuver in the
soft, sleety snows of
→ Canada's eastern coast
region, clears railroad
tracks in New Brunswick.
It can be pushed or
pulled by a locomotive

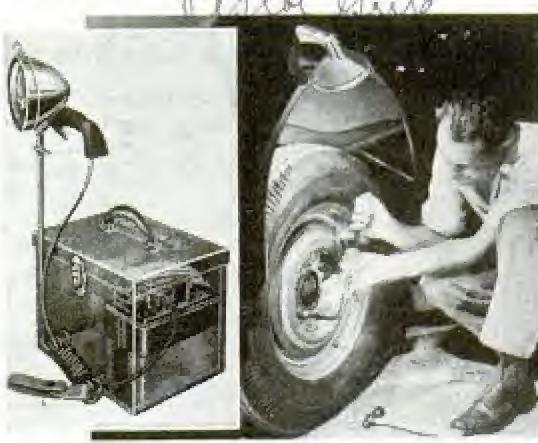
Heavy duty snowplow
borrows compressed air
from locomotive for ex-
tending and retracting
massive steel wings. A
cupola on top houses
controls and protects
operator from elements
↓



When winter covers Canada's railroads with a heavy blanket of snow, it is the work of giants to clear the lanes and keep the roads in operation. For use in flat, open country where drifts pile high, a heavy duty, single track, wing type snow plow, weighing 81,600 pounds, is among the newest to go into action for the Canadian National Railways. This type of plow depends on a locomotive to move it. It is equipped with couplings at both ends, the rear coupling being used when the plow is in operation, and the front one is handy for towing the plow in the yards or spotting it on a track. The heavy steel wings at the sides may be extended and retracted at will by the operator stationed in the cupola. Compressed-air power furnished by the loco-

motive operates the wings and also adjusts the height of the drop nose or point to cope with varying snow conditions. The overhanging roof prevents snow from being pushed over the top of the plow. Rotary plows are used in deep cuts and in the Rocky Mountain territory where snow-slides are encountered. Plow operator uses a steam whistle to signal the engineer.

'Trouble Light' for Motorists Attaches by Suction to Fender



Attachable by a vacuum cup to the automobile fender, a versatile "trouble light" for motorists throws a beam a quarter of a mile. It can be connected to the car battery, and with adequate length of wire proves useful as a spotlight from the driver's seat, for changing tires, inspecting the motor or lighting the trailer. It has a pistol grip, and a hook for hanging in convenient places. The light can also be had with a portable battery and with various pedestal mounts for use in camp or on the farm.

Lamp is shown on pedestal with portable bat-
tery and attached to fender by a vacuum cup

1196 Warship's Fire Squad "Armored" Against Heat



Firemen in asbestos coveralls rushing across the deck of H.M.S. Furious, British aircraft carrier

✓ Frequent drills are conducted by the fire squad of H.M.S. Furious, one of Britain's airplane carriers. When the alarm is given,

they don asbestos suits, which enable them to withstand intense heat, and rush extinguishers to designated part of the ship.

1183 Portable Hydraulic Elevator Handles Bomber Engines

To facilitate installing, removing and servicing the engines of giant bombing planes, what probably is the largest hydraulic portable elevator, 26 feet high, has been built by Lyon-Raymond Iron Works, Greene, N. Y. It is equipped with both an elevating boom and removable platform, so it may be used either with or without the platform. A hydraulic hoist powered by a three-horse-power motor elevates the platform and boom, which have a lifting capacity of 5,000 pounds and speed of about 12 feet a minute with maximum load.

¶ The number of licensed airplane pilots in the United States more than doubled in the year ended Oct. 1, 1941, totaling 91,442 against 44,000 twelve months earlier.



Hydraulic lift can raise 5,000 pounds on its platform or with the boom

2/1052
Cherry Works
U.S. Steel Corp.

CINDERELLA METALS

Schaeffer Donomes



Freight-car trucks like these being lifted by a powerful electromagnet in a Jersey City, N. J., junk yard are scrap of excellent quality



Waste from tin shear lines of a steel plant enters a scrap baler

If YOU haven't joined the treasure hunt for forgotten bits of junk in your garage and attic and barnyard, it's high time you did. You may find treasure for the national defense, pay dirt for yourself.

For junk, the long-neglected and grimy stepchild of the metal family, has suddenly blossomed forth as the fair-haired Cinderella of American industry, with the humble junk dealer as guardian, the manufacturer

as employer and Mr. Average Citizen as godfather of the precious castoff.

So important has scrap metal become that serious industrialists say the scales measuring success or failure of the nation's defense effort will be tipped either way, according to the number of millions of tons of junk that are dumped from American farms, homes and garages this year.

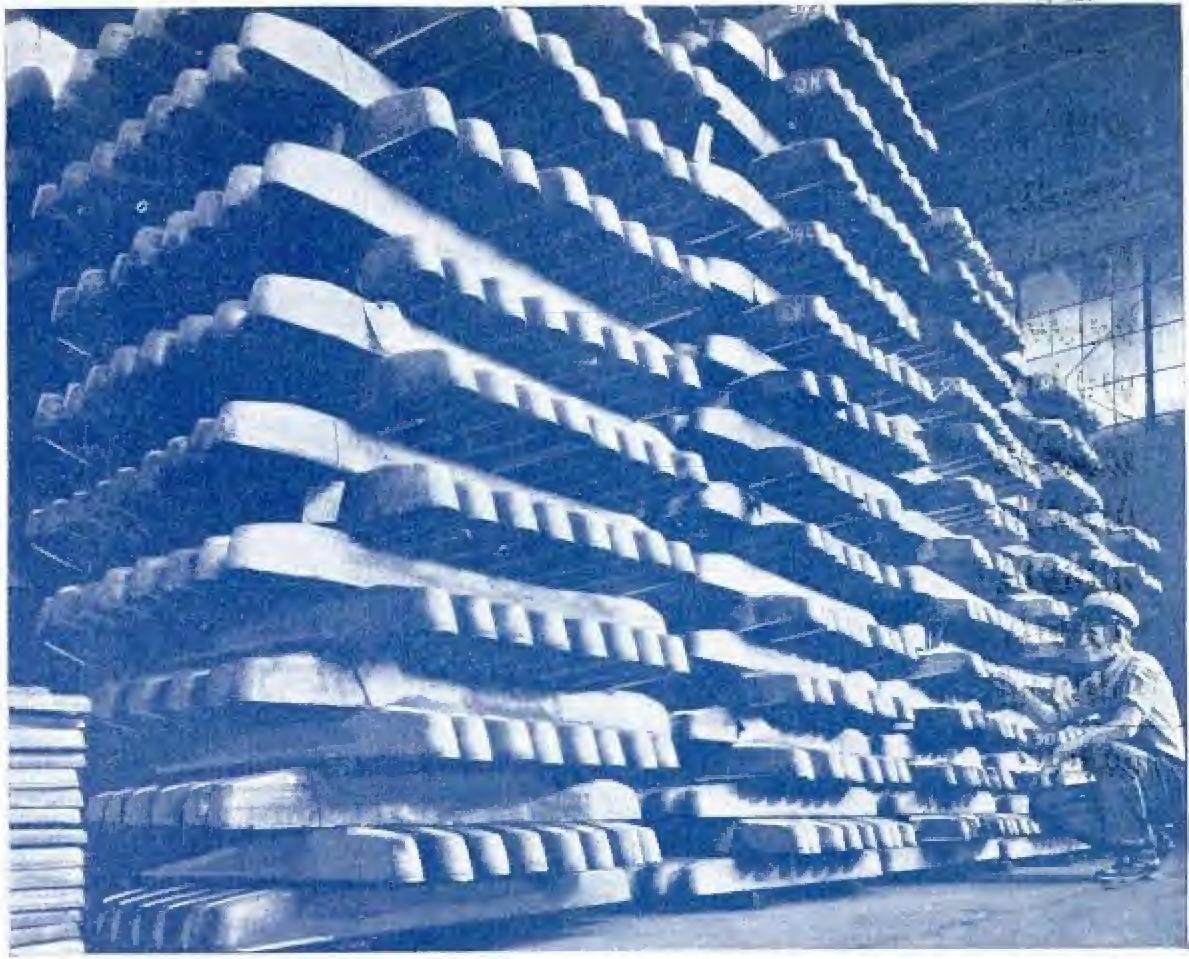
They also assert that the nationwide aluminum drive, spectacular though it turned out to be with 14,000,000 pounds gathered, and the other scrap round-ups since, are only mild flurries compared with the campaigns which are to sweep the nation soon. In return, millions of dollars will stream back into the pockets of Americans. Junk is a new cash crop.

Because of government attempts to fix prices below the emergency value of the stuff, the junk bootlegger has already appeared on the scene, getting as high as 40 cents



Salvagers haul away material from a community scrap pile

L1052



a pound in the case of aluminum utensils — when the ceiling fixed by Uncle Sam was 12 cents a pound—from small manufacturers desperately in need of the metal because of priorities.

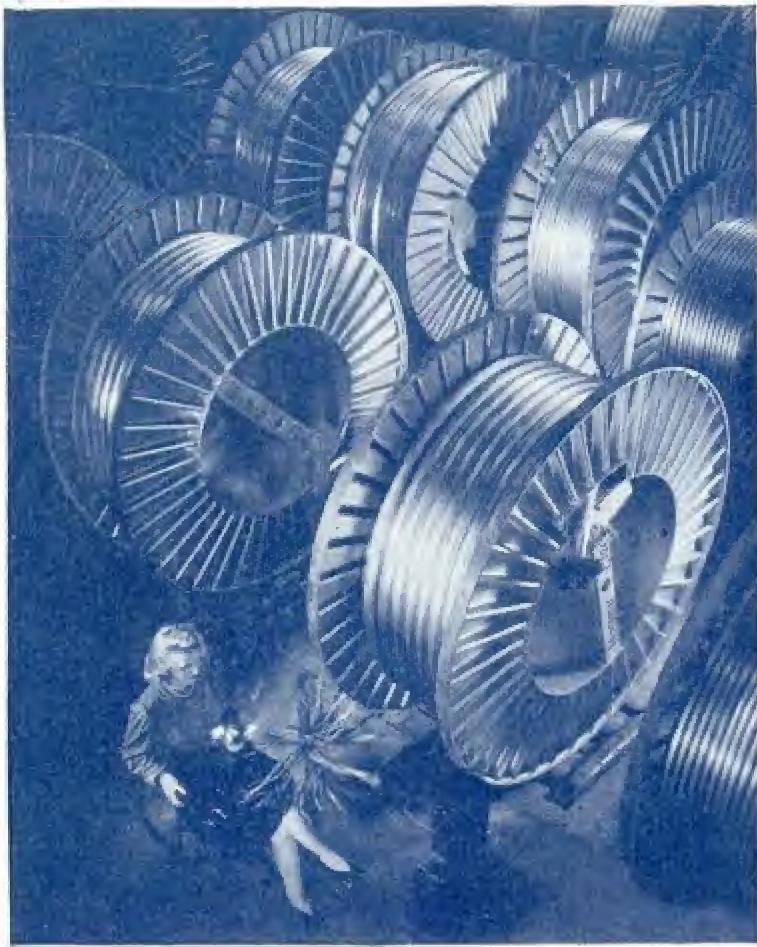
But if any metal is bootlegged around the government's restriction, it will not be that moved from the millions of farms and homes, the 200,000 small junk yards and the thousand or more wholesale dealers' establishments. The first two individually do not have sufficient quantity to make bootlegging practical and the big dealers operate under the rigid code of ethics of their own Institute of Scrap Iron and Steel.

Copper bars at a smelting plant, ready to be shipped to rod mills and thence to Western Electric works to be drawn into copper telephone wire

Damaged or obsolete telephone cable is stripped of lead sheathing, and all metal—even sweepings—is melted, refined and used again



2/1052



In one of the final tests of the electrical properties of telephone cable, an inspector connects the testing leads to a pair of conductors

Left over from the first world war, a tank that never saw service enlists again for defense. It is broken up for scrap

Scrap iron collector helps two boys with a load of miscellaneous junk they have found



airland by
POPULAR MECHANICS

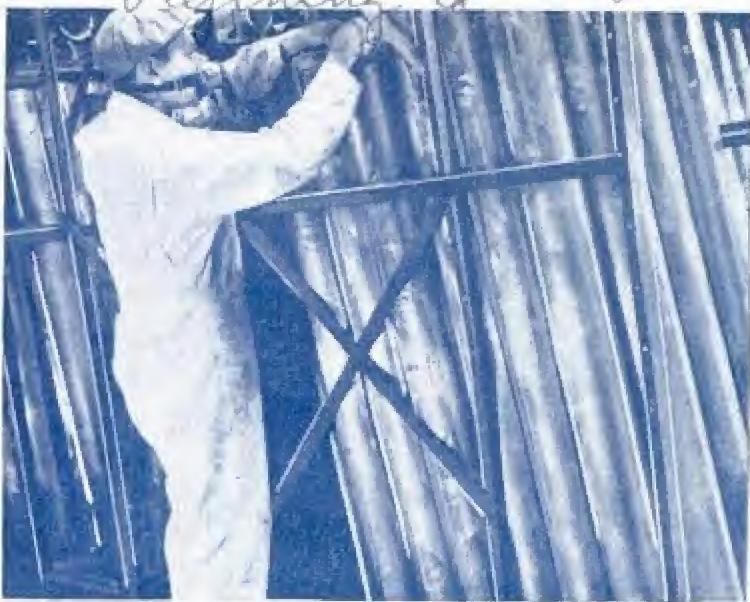
8 1052

and brass in a third, and so on.

Each pile should be weighed or estimated and with these figures you can drive to the nearest junk dealer—there's one in nearly every town—and get his best offer, delivered. If the price is not satisfactory, another dealer should be approached. Remember, the junkman is just as anxious to buy as he is to sell and the metal should be sold just as any other crop. The fact that it has been collected, partly sorted and is to be delivered at the junk yard should bring a fair increase in price over that offered by the junkman at your door. In this way, the seller is getting paid for his time, labor and the vehicle used for hauling, as well as for the metal.

Just because \$20 per ton is quoted for scrap in Pittsburgh does not mean you should get a cent a pound for your iron. In the first place, scrap is sold by the gross ton, which is 2,240 pounds. Then, too the quotation is for No. 1 heavy melting steel, a fine grade which represents about 10 percent of the total tonnage, there being 74 other cheaper grades. Again, the price is lower in other cities. Grading the scrap

Nassau Smelting & Refining Co.



These lead sleeveings will be used to protect joints in telephone cable

costs dealers around \$3 a ton and transportation can run from \$3 to \$4 a ton more.

Cost of operation and transportation differ so much by locality that no fair general price can be quoted for scrap iron or steel as it is turned over to a dealer to begin its journey back into the furnaces. The same is true to a varying degree of other metals, such as copper scrap which is pegged at 10 cents a pound for top quality.

Benjamin Schwartz, one of the founders of the Institute of Scrap Iron and Steel, points out that the small town junk dealer

(Continued to page 192)

A bulldozer assembles 152 tons of aluminum in Brooklyn yard

High-speed saw slices through bronze billets



JANUARY, 1942

Nassau Smelting
& Refining Co.

L1166

Pull of Tab Turns Leaves Of Multi-Picture Frame



Leaves of picture frame turn up as base is pulled

Pull the tab at the base of a picture frame on your desk and the leaves turn up, one after another, to show as many as eleven photographs framed in transparent envelopes. The frame becomes, in effect, a family album. This same automatic tab principle is available also in photograph albums of large or pocket size. As the tab is pulled, the pages turn to exhibit a series of pictures. No pasting is required. The pictures can be changed easily, but while in the acetate pockets they are protected from dust and handling.

L1161

Sugar Identified and Measured With Polarized Light

Identification and measurement of sugar in babies' diet, important because only certain kinds pass as nutritional factors through the intestinal walls to be absorbed



Light polarized in tube reveals sugar in solution

by the blood stream, has been simplified by a new medical instrument that uses Polaroid film. The polarimeter is successful because sugar has the peculiar property of rotating polarized light. Light passing through a sample tube between two Polaroid disks is sighted by a small telescope. Crossing the disks darkens the tube, but if a sugar solution is placed in the sample tube, the field becomes light. Rotating one of the disks restores darkness. Sugar in the solution is measured by a scale and a drum on the instrument. In this way it has been determined that honey, for instance, is largely a left-hand sugar, a levulose, because it rotates polarized light counterclockwise, while corn syrup rotates polarized light clockwise and is a right-hand, or dextrose, sugar.

L1012

"Gun" Unit Tests Electric Bonds To Stop Radio Interference



Pistol-grip tester locates faulty electric bonds

Shaped like a gun for ease in handling, a self-contained meter speeds up testing of electric bonds intended to prevent interference with radio reception and transmission as well as injuries from static sparks. The unit is simple to read and the operator does not require technical knowledge. Electric bonds, widely used in the manufacture of planes, tanks and other motorized military equipment, are connections usually welded in place to insure constant electrical contact between the body and objects attached to it by mechanical joints, such as doors. Unless these connections are held within the safety limit, electrical resistance may be set up which sometimes impairs radio efficiency. Used periodically, the test discloses loose or corroded joints before serious trouble develops.

POPULAR MECHANICS

10/4. The Mansfield Co. 551 University
Av. St. Paul, Minn.

Hinged Stairway May Be Raised Out of Way

For installation where lack of space will not permit building a permanent stairway, there is offered a pre-built stairway that swings to the ceiling when it is not in use. The equipment includes an open framework to be installed in the floor above, and a cover that contains a sliding weight to counterbalance the stairs. This cover may be refloored to match the surrounding finish if desired. Stairs raise and lower easily at a slight touch.

L1034

Stars Redden in Gas Cloud Enveloping Solar System

Noticing almost imperceptible differences in the colors of stars in different parts of the sky, three University of Wisconsin astronomers have discovered that our solar system is immersed in an obscuring layer of gas 1,600 light years thick, extending out 100,000 light years to the limit of the Milky Way. Stars are slightly reddened when their light passes through the thin cosmic clouds, much as the sun reddens when seen through thicker atmosphere at sunset.

Science Service
Oct. 4.



Stairway is counterbalanced by sliding weight in hinged cover

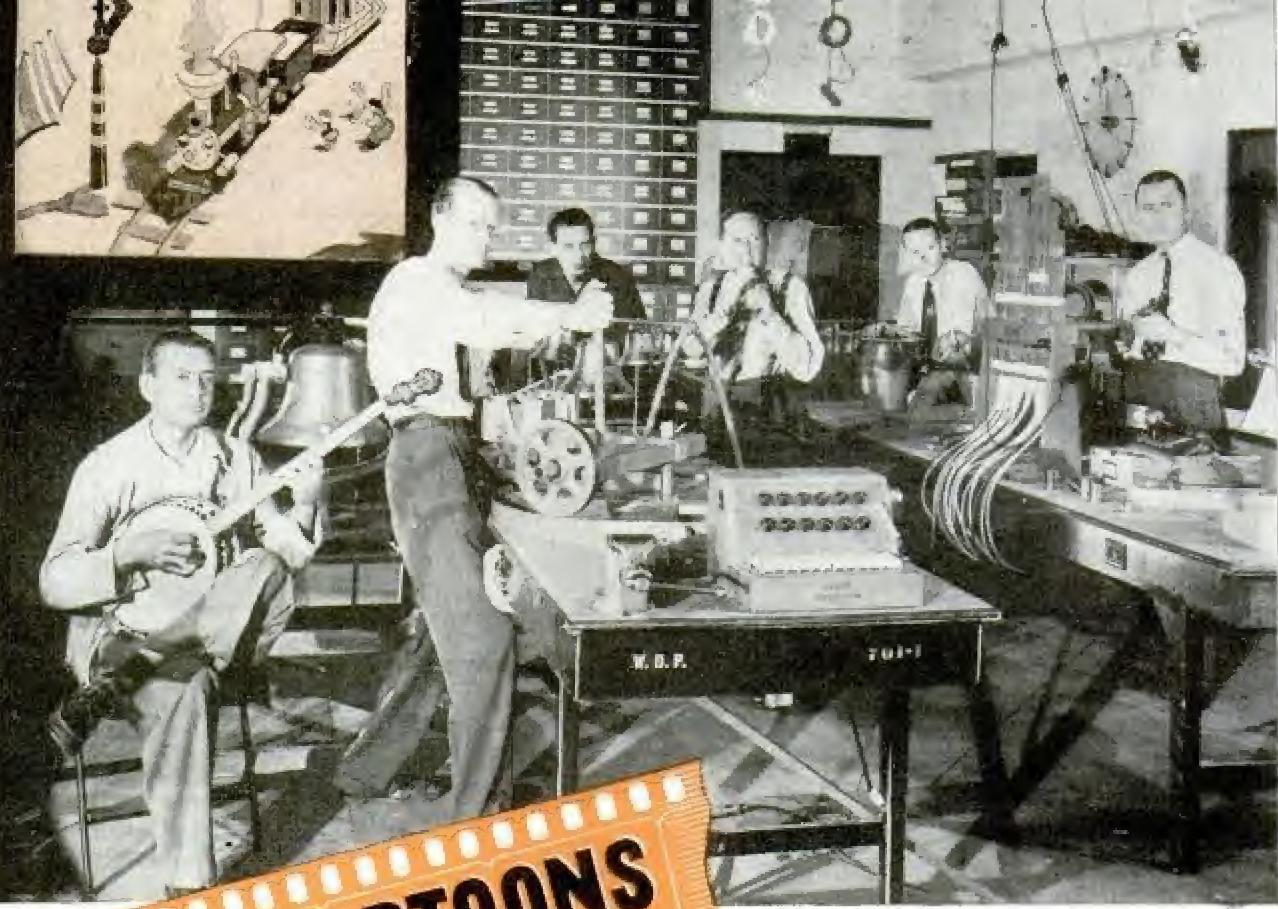
Big Pipes for New Oil Line Travel on Top of Tractor



Tractor carries five tons of pipe on top of special rigging

JANUARY, 1942

Pat Skowling Pictures
1611 Cormorant, Hollywood, Calif.



MOVIE CARTOONS COME TO LIFE

2804



Cartoon and sound effects men team up in a new technique of the Disney Studios

By Ub Iwerks

Technical Supervisor, Walt Disney Studios

Hollywood City
WALT DISNEY again lives up to his reputation for always creating something "different." In his latest full-length feature he has combined two of America's original arts: flesh-and-blood motion picture acting and pen-and-ink cartooning, in a new kind of entertainment.

As one harried Disney employee said recently: "Walt's always making pictures nobody can describe!"

The decision to combine acting and animation came about through an odd coalition of circumstances. First, it was well known that "trailers" showing the inside working of Disney Studios were immensely popular with motion picture audiences;

These sound men are creating thunder with shot-filled balloons. The masks are to protect their faces if a balloon bursts

An elephant models in a Disney art class. The trick is to put a human expression on the animal drawings

second, Robert Benchley had expressed a desire to do one of his famous "How to" shorts at the Disney Studios; and third, there was that challenging idea of combining cartoons and real people.

Put the three together and you have "The Reluctant Dragon," a yarn about a man who goes to the Disney Studios to try to sell Kenneth Grahame's story of a Ferdinand-like dragon who doesn't like to fight. Benchley's adventures in the animation department, sound effects room, paint laboratory and finally the story conference room presented an excellent chance to combine cartoons and acting.

Cartoons and actors have been combined before in a crude way—just as talking pictures were possible before the great Hollywood



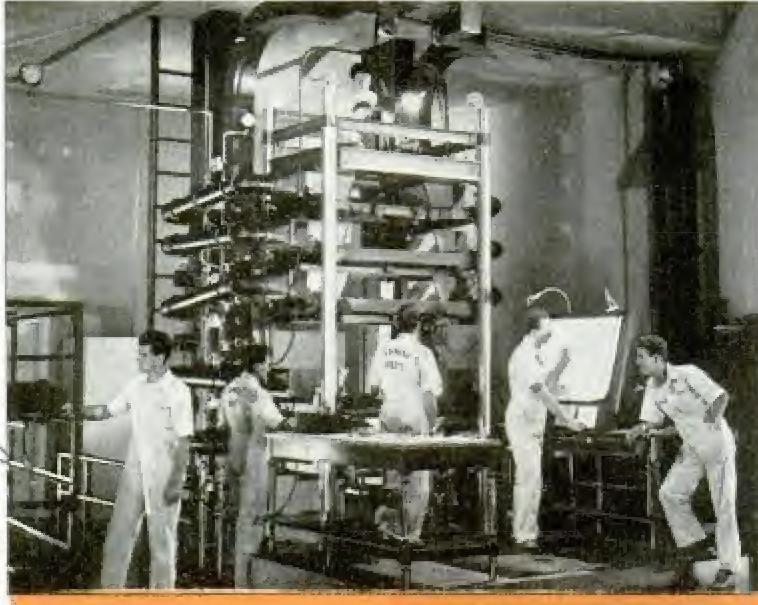
Mickey Mouse shakes hands with Leopold Stokowski in "Fantasia," illustrating how animated cartoons and "live" actors combine on films →

Unusual shadow effects are created for the movie through the use of carefully placed, high-powered spotlights thrown upon background screen ↓



1930 4

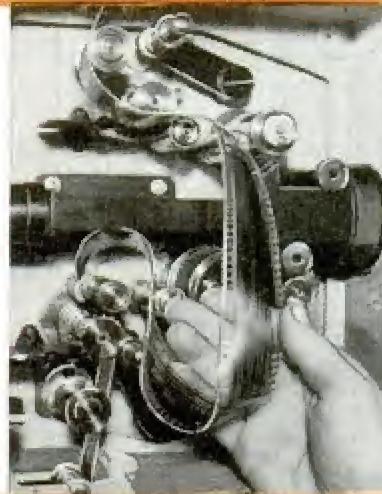
and Gilbert Wright & Charles
Walt Disney Studios, Burbank, Calif.



Fourteen-foot camera is used to create three-dimensional effects, a new development of Disney organization; camera cost \$75,000

At right is a closeup of the "Fantasound" film showing its four separate sound tracks—one for over-all control and three others to be connected with loud speakers spotted around the theater

Frances Gifford tries the magic of the Sonovox on Bob Benchley. With it his voice can be made to sound like whispering wind, rattling dice, or talking train whistle



Sound Renaissance of 1928. But Disney has taken an idea off the musty shelves and breathed life into it. A little experimenting in this direction was done in "Fantasia." Remember the scene where Mickey Mouse walks up to the stage and shakes hands with Leopold Stokowski, director of the orchestra? Well, this is how it was done:

Stokowski was photographed first—shaking hands with thin air. Photographic prints of the scene were made and numbered. Then the animators placed drawing paper over the numbered photostats on a light board and matched Mickey's action to that of Stokowski. Mickey was inked and painted solid black to give the effect of a silhouette. When it came to photographing Mickey's action, a camera

A genuine train whistle generates a realistic blast of sound for a cartoon—and look at the size of the movie locomotive!



2804

21019

with a projection movement was used. In other words, the camera itself served as a projector. The camera was lined up on the camera crane and the film of Stokowski's action put in it and adjusted until it synchronized with that of Mickey.

Thus, with a negative of both Mickey's and Stokowski's action, a double printing of the two produced a "dupe" negative. To you in the theater it appeared as if man and mouse were together shaking hands.

These combinations of acting and animation were made possible by new techniques worked out in the Disney Studio. Animators, sound men, scene painters, cameramen and cutters all had a hand in them.

Transition from "live" actors to cartoon actors is sometimes accomplished by clever cutting. Donald Duck is seen on a drawing board over the shoulder of an artist. The camera swings down to a closeup and when the still picture fills the frame, animation is substituted and Donald comes to life.

Where moving cartoons and live actors are to be seen on the screen at the same time, the difficulties are greater. For example, in "The Reluctant Dragon," a cartoon of a train with sound-effects men below tooting whistles, puffing bellows and making other locomotive-like sounds created a problem. One way to do this was by ordinary rear projection, as done in many ordinary "live" action pictures. For example, an automobile is supposed to be proceeding down Fifth Avenue and you see Manhattan scenery whiz past. The scenery would be shot in New York and the car photographed later in Hollywood.

We could have achieved the same effect by projecting the cartoon on the back side of the screen. But at the time the live-action part of the film had to be shot, the cartoon had not been finished. To have waited for completion would have meant loss of three months. So we had to do it a different way. The screen, a piece of Masonite, was painted white with a black border. Sound effects men were placed below and the whole scene was photographed. It looked good—except that the screen was perfectly blank.

To put the cartoon on the screen three months later, we used a procedure similar to that of Mickey and Stokowski. We placed the cartoon film in the camera and aligned the field to fit the screen area. A traveling matte blocked out the live-action

(Continued to page 189)

JANUARY, 1942

Rowing Machine for Child ✓ Pumps Up Toy Balloon

2-1019
ao-Bld



Child's rowing operates pump to inflate toy balloon

Amusement for the child has been added to a juvenile rowing machine now on the market, inducing the youngster to take healthful exercise. As the child rows, a pump attached to the lower end of the handle inflates a balloon mounted at the front of the machine.

2-1100

Pocket-Size Fiber Fuse-Puller ✓ Averts Danger of Shock

With a handy small-size fuse puller, burned-out fuses can be replaced without danger of shock. It handles any fuse having a diameter of $\frac{1}{4}$ to $\frac{13}{16}$ inch. Made of strong fiber, the puller can be carried in the pocket or hung on the fuse-box cover.



Safe fuse-puller of fiber does not transmit shock

Littelfuse, Inc. 37
4757 Avenue of the Americas
New York 19, N.Y.
Chicago 6, Ill.

Mickey Mouse machine
envelope. Mickey Mouse
envelope. Pa.

2026

"Stop-and-Go" Circuit Breaker ✓ Guards Rural Power



Circuit breaker recloses circuit five seconds after shut-off

Frequent long shut-offs of electric current in rural areas will be avoided, and maintenance costs will be reduced, with a new "reclosing" circuit breaker developed by Westinghouse engineers. Much as a policeman directs traffic, the circuit breaker automatically stops the electric power for five seconds whenever a short circuit occurs, and then permits it to start flowing again. Since about 80 percent of all power faults are temporary, the brief period between "stop" and "go" is sufficient for most troubles to correct themselves. However, if the power fault fails to correct itself, the breaker will open and close only twice. The third interruption would break a specially designed mechanism which must be repaired by "trouble shooters."

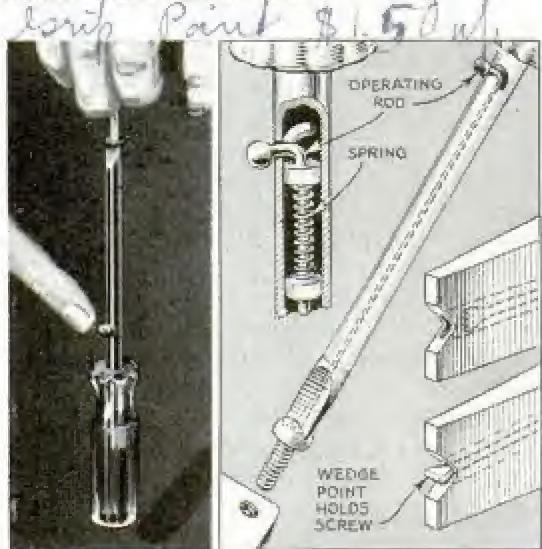
London, England

by Miss Mary D. Waller of the London School of Medicine for Women, who reports several useful applications of the squeak. In the same manner quartz can be distinguished from common glass, and semiconductors of heat from nonconductors. The squeak, or rattle, occurs when a pointed piece of Dry Ice, or solid carbon dioxide, makes contact with a conductor of heat such as a metal plate. A portion of the "ice" at the point is converted into gas, which pushes away the plate. This in turn cuts off the passage of heat, stops the conversion into gas, and permits the plate to return into contact. The cycle is repeated from 1,000 to 4,000 times a second.

L953

"Key" Within Screwdriver ✓ Holds Screw by Its Slot

Gripping the screw with a wedge that turns inside the slot, a screwdriver clings firmly to the screw until it is fully set. Since no part of the tool extends beyond the screw head, it is especially useful for inserting screws in countersunk holes. To make it take hold of the screw, a small lever on the shaft is pushed forward and flipped to one side. This causes a flat-ended rod to project through a V cut in the blade and wedge in the screw slot.



Sketches show in detail how wedge grips the screw

"Dry Ice" Causes Gems to Squeak ✓ If They're Genuine

Squeaks emitted by Dry Ice when it is pressed against a diamond or pearl indicate that the gem is genuine, since imitations produce no sound. This was revealed

38 Service Bureau
Sept. 16

POPULAR MECHANICS

1603 N. Milwaukee Avenue
Chicago, Illinois

Powered Chair Ferries Passengers at Airport

Passengers and pilots arriving in their own planes at Washington National Airport are taxied in a scooter chair to the administration building from the end of the field where private ships park. The chauffeur operates the vehicle from behind the wide front seat, and there is space for luggage on the floor between the driver and passengers.

Scooter chair transports passengers and pilots of private airplanes between far end of field and the administration building



Metronome Beats Drill Rhythm to Set Pace for Soldiers



Soldiers in training at Camp Callan, Calif., are marching to the rhythmic beat of an electric metronome that never wavers from the correct tempo. The timer is hooked up to an amplifier and a large loud speaker so it may be heard by squads as they drill.

Mounted on a table at the drill grounds, metronome sends out its staccato beat, amplified through a loud speaker, that helps marching soldiers keep stepping at the prescribed pace

Visual Indicator for Radio Beam Relieves the Pilot of Headphones

Airplane pilots who suffer discomfort wearing headphones to hear the signal that tells them whether they are flying on the beam can switch to a visual beam indicator, invented recently, that enables them to discard the headphones. The beam indicator, a glowing tube, flickers when the plane flies into the twilight zone at either side of the beam, and glows steadily when on the course. An automatic switch disconnects the indicator when weather reports come through a small speaker.

Visual indicator contains tube that glows steadily while plane flies beam, flickering if plane strays



L867

Clamp Provides Extra Hand By Gripping Work Firmly



Strong spiral springs give the clamp a firm grip

An extra hand for the home craftsman is provided by a clamp that holds the work in a powerful grip. Used in place of the conventional screw clamp, it has the advantage of taking hold immediately. There are three sizes, with graduated gripping power supplied by a spiral spring.

L1013

Giant Bearing for Aluminum Mill ✓ Carries Enormous Weight

Their capacity rating 30 percent greater than any other bearings, four Timken tapered roller bearings, weighing 9,070 pounds each, have been produced for installation on the back-up rolls of the new



Comparing largest bearing with smallest, in the hand

reversing hot mill of the Aluminum Company of America at Alcoa, Tenn. With a 51-inch outside diameter and 36-inch width, the bearings have a bore of 35½ inches, and their mill separating force capacity, at mill speed, approximates 8,300,000 pounds. Each bearing contains 136 rolls, divided among four "cages," the small rolls being 7½ inches long, 4 inches in diameter, and weighing 23.37 pounds.

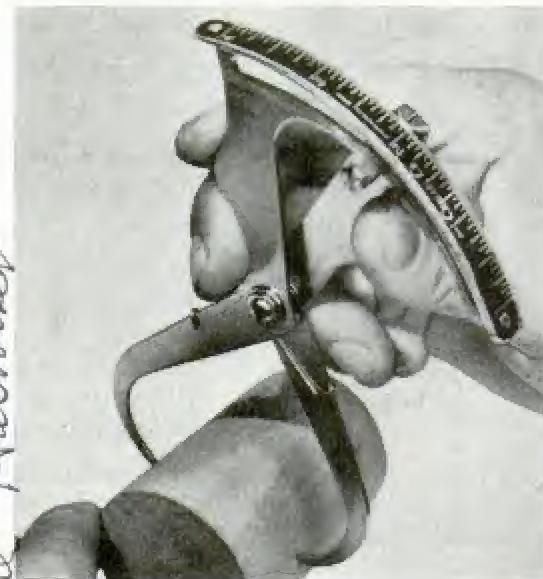
L1157

Plating Waste Zinc on Steel ✓ Saves Defense Metal

Waste zinc can be plated on steel by a new electroplating process. Thus may large quantities of new zinc be saved for defense. The resulting zinc-coated steel wire or strip is said to be equal to that produced by conventional plating methods. The zinc used is dissolved from galvanizers' skimmings, brass foundry fume, or organic reduction residues or ore, by a solution of ammonium chloride and ammonia.

L1003

Caliper With Scale on Its Back ✓ Is Easy to Read



Scale on back of caliper has easy-to-read markings

Quick measurements can be made with a four-inch direct reading caliper having the scale mounted so it is always in front of the user. Graduated in thirty-seconds of an inch, the bright figures on a black background are easy to read. A spring tension permits it to be used with one hand and it can be locked in any position.

Leygack

United Air Lines.

2808

Striking photo of Chrysler's specially-built "Thunderbolt" and modern airliner shows how engineers are employing aerodynamic design in experimental work on "autos of the future"



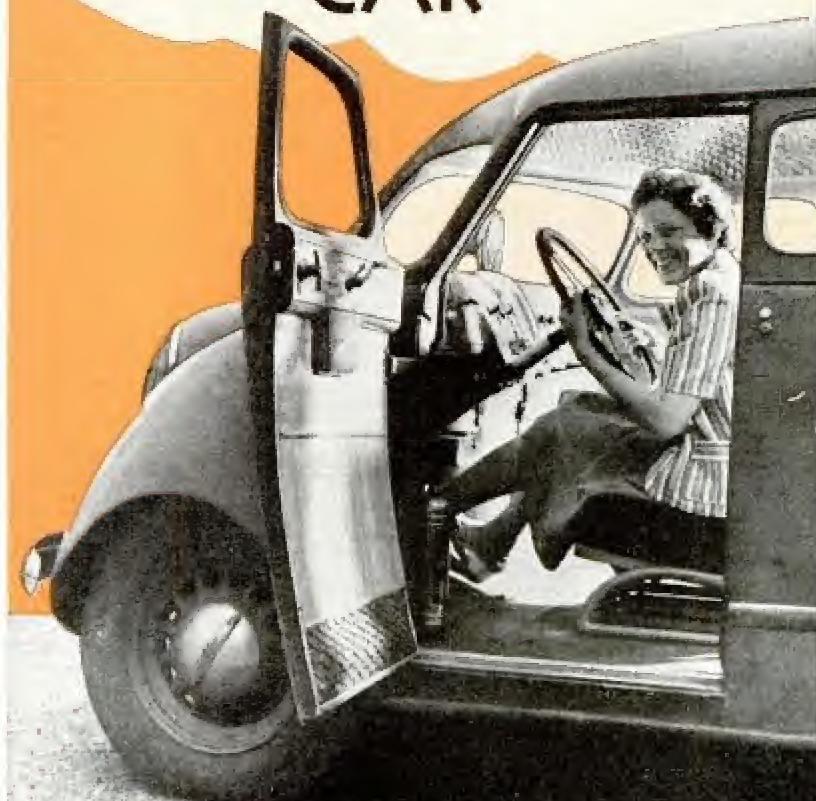
By William B. Stout
Auto and Airplane Designer

IT IS possible today to build an automobile bigger than a Buick, more powerful than a Cadillac, better riding than any previous car, yet 50 percent more economical, 50 percent lighter in weight and 50 percent more spacious inside than are present passenger vehicles.

Since this automobile is not being built, even though it is possible, we must regard it as the car of the future. And I believe that it will come at a time not very distant.

But from whence will it come? My answer, based upon actual experience in building both automobiles and airplanes, is that it must be the brain child of the aviation industry. The reason why it cannot come from the automobile industry is that too many tools have frozen that industry into one position. The idea of 1,000 cars per day has obsessed the manufactur-

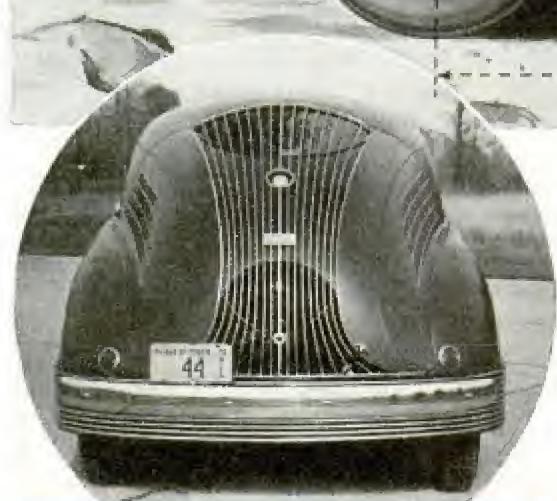
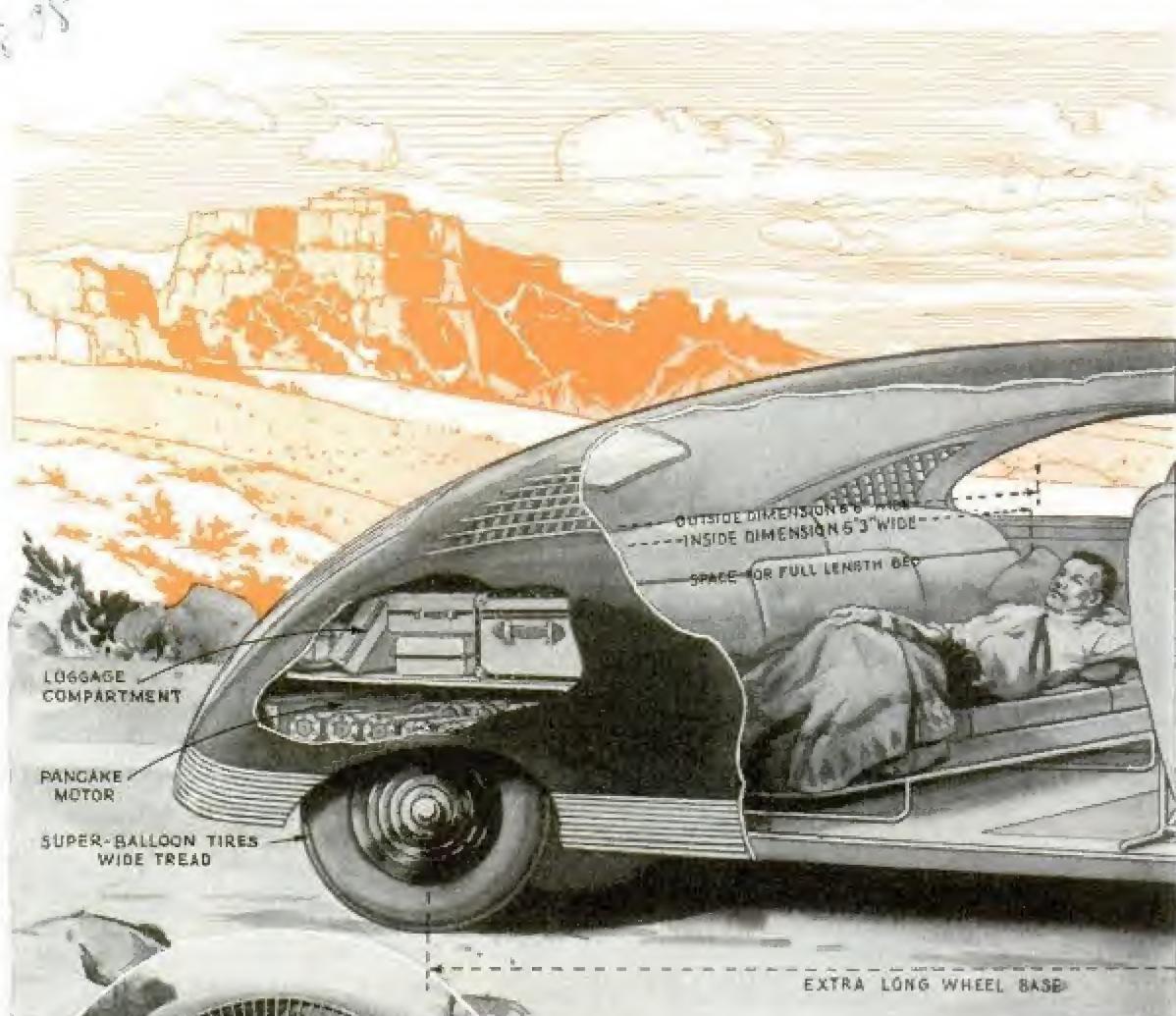
Out of the Air --- TOMORROW'S CAR



Driver sits quite close to front of car in the Stout Scarab, shown with door open.

JANUARY, 1942

*Stout Scarab Corp.
2124 Telegraph Road
Dearborn, Mich.*



Above and on page opposite is artist's idea of tomorrow's automobile as suggested by the author. Note pancake motor at rear

ers with a tradition of dies and production machinery they cannot overcome long enough to do a new car on any other basis.

A large percentage of the space in today's automobile is allotted to machinery, but in tomorrow's "wingless plane-car" the machinery will be hidden so that you will have to look for it. The motor will be concealed under the rear seat, or just behind it, probably beneath a luggage compartment. Naturally this means that I expect the car to be powered with an engine at the rear, instead of the front. This engine will be air-cooled, most likely developed from the small airplane types now being built for flying use, and will gain 20 percent economy merely from the fact that it is air-cooled and runs at a higher temperature. Being the pancake type—horizontal

Circle and bottom, views of Scarab's exterior; note rear-end treatment (circle)



construction with the cylinders arranged on their sides instead of standing on end—the engine will fit low down in the back of the vehicle and leave plenty of room for luggage.

One feature I am confident will be incorporated into this car will be a rear seat at least six feet wide, perhaps three or four inches more, giving space for a full-length couch or bed to be used on long tours or by the drowsy passenger. This means that the overall width of the automobile will be about six feet, six inches—not a great deal more than the present car, but the difference is that tomorrow's car will be arranged so that the width will be employed for the comfort of the passenger rather than for a place on which to hang fenders.

Today's auto—even the largest—has a front seat approximately five feet wide and a rear seat several inches smaller, while the outside road width at the fenders is six feet, four inches.

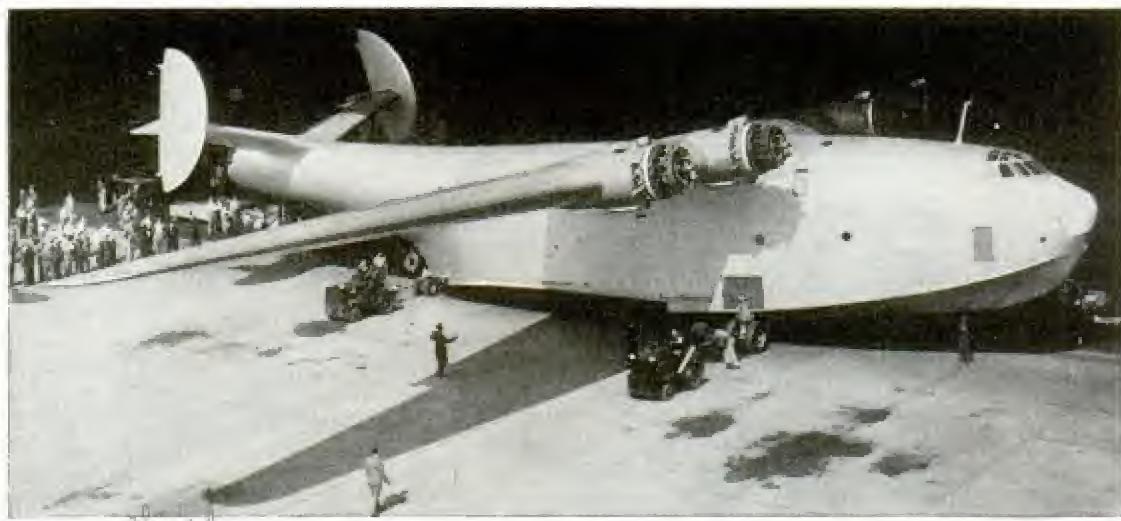
(Continued to page 164)

Adjusting rubber springs which also serve as shock absorbers on the Stout car



L:113

Seventy-Ton Flying Battleship Prepares for Dip



Baltimore, Md.
Tractors haul the nearly completed 70-ton flying boat from the factory for its first glimpse of daylight

21062.
Up swung the doors of the vast factory hangar at the Glenn L. Martin plant the other day, and two tractors towed into daylight the world's largest flying boat. Almost ready for its first dip, this battleship of the air—destined for the U. S. Navy

—weighs 70 tons. Similar in some specifications to the giant land plane recently built for the army by Douglas, the Martin XPB2M-1 has a wingspread of 200 feet and is powered, like the Douglas, by four 2,000-horsepower Wright engines.

Portable Photo Speed-Lamp Takes Super-Fast Pictures

21062.
Photographs can be taken as fast as 1/20,000 of a second with a new portable

counterpart of the Edgerton speed lamp. The reflector and flash tube assembly is mounted on the camera, while the power unit is strapped separately over the photographer's shoulder.

21075 Low-Grade Manganese Recovered By Flotation Process

21075
Production of manganese in the United States has been limited to about three percent of domestic needs, because until now the metal could be extracted only from high grade ores containing 48 percent or more of manganese. As a result of a new treatment of low grade ores, developed by the U. S. Bureau of Mines, this country will be made independent of foreign sources at a time when manganese is of vital importance in producing high-grade steels demanded by defense industries. The method involves the development of a new reagent, known as DLT-958, which floats much of the worthless material away from the ore, leaving a higher concentrate from which the metal can be extracted by the usual processes. It is estimated that

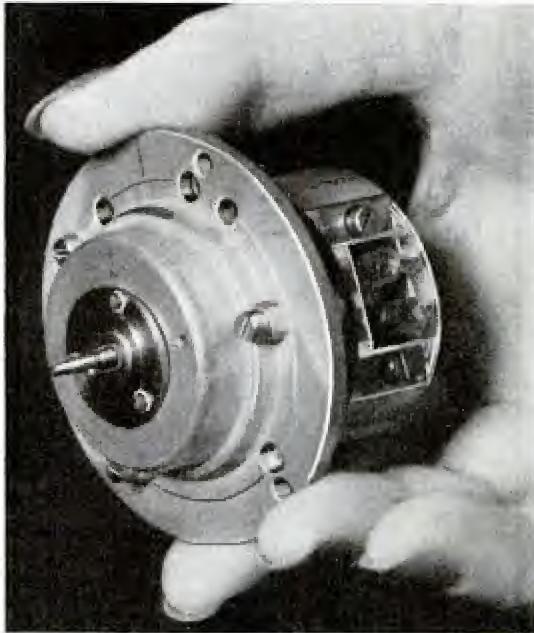


21075
Super-speed lamp "freezes" action at 1/20,000 second

L 1091
there are nearly a million tons of ore containing 10 percent or more of manganese near Las Vegas, Nev., and the Bureau of Mines has built plants at Boulder City where operations have already begun. In the first test, ore containing 18 percent of manganese treated with the new reagent left a concentrate containing 53 percent.

L 813
**Seven-Ounce "Telltale" Motors
✓ Check Behavior of Plane**

Featherweight motors built with a watchmaker's precision are being turned out by the hundreds to contribute important parts in the safe operation of American warplanes. Weighing but seven ounces each, these tiny Autosyn motors are accurate within 1/10,000 inch. Their function is to tell the pilot of the position of various moving parts of the plane, and as many as 20 may be installed in one ship. They work in teams. For example, one transmitter motor operating on a 27-volt, 400-cycle alternating current is attached to landing gear and also to a receiver motor which is attached to a dial on the instrument panel. The slightest movement of the landing gear actuates the rotor of the transmitter motor, which causes a similar movement of the receiver rotor and thus moves a needle on the instrument board, showing the pilot the exact position of the landing gear. Similar installations register various other phases of the plane's mechanism.



Tiny motors like this actuate plane's indicator dials

Dolls Luminous in the Dark Amuse Children at Night

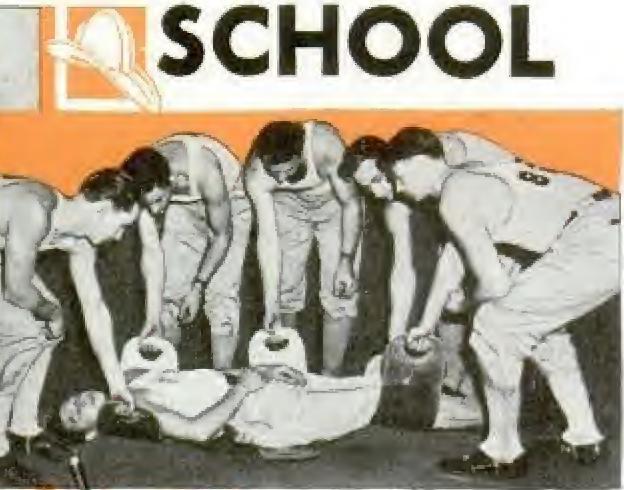


Two views show dolls in the light and in darkness

Tiny tots who are afraid of the dark can be pacified with soft dolls that light up in darkness with various colors, including green, yellow and lavender. It is only necessary to expose the dolls to daylight or strong electric light to make them glow. Handling does not hurt either the toys or the children. The doll's clothes may be washed and ironed without affecting the glow if they are not exposed to prolonged moisture.

To learn where to buy commercial products described in these pages, see the index.

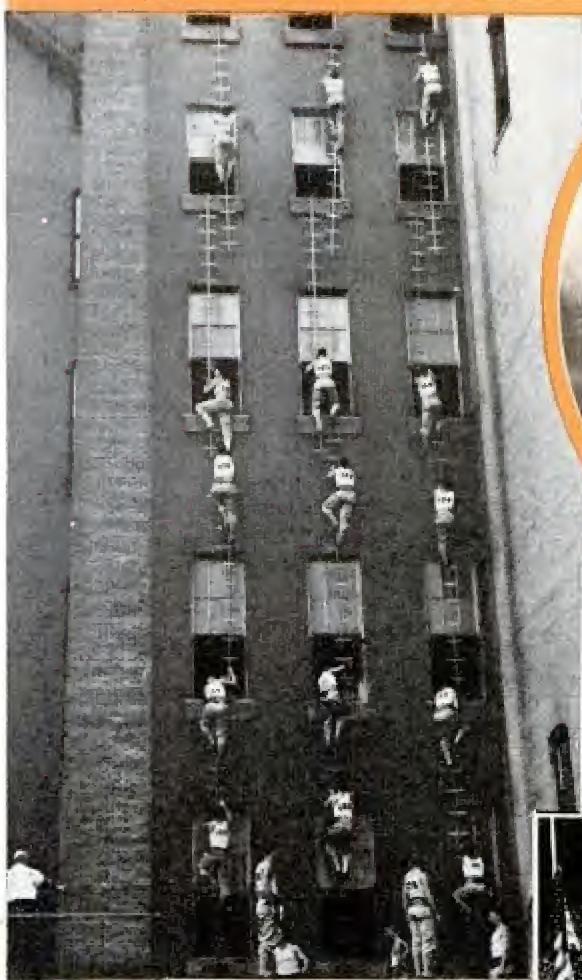
36 10 47
End. Allie Warren, Elly St. 2nd year
SCHOOL



↑
Five stories up, and nothing holds this fireman but his safety belt. He is taught to rely on it as a flyer does on his parachute

← Legs together and arms out of the way, a fireman drops into the outstretched net in a demonstration of perfect jumping technique

for FIRE FIGHTERS



The whole class swarms up on chains of scaling ladders, advancing together a floor at a time and passing up the ladders to the men ahead. Hours of this develop toughness and self-reliance



JANUARY, 1942



Gas masks are essential in basement and subway fires, and the New York trainees get their fill of rescue work in masks. Here a rescuer, who has gone down into a cellar filled with sulphur smoke to bring out one of his fellow "smoke eaters," emerges with the "victim" slung over his shoulder, a battalion chief standing by to direct



For 90 minutes at a time the probationary firemen handle and climb 35-foot, 164-pound ladders (above). They learn to support themselves with the "fireman's hold," in which the right leg is swung over a rung and right foot hooked around the ladder's beam—this is used when there is no safety belt. Left, proper way to carry a person, one arm over shoulder and weight high on back. After six months the fireman is ready for any emergency

L 869 Traffic Actuators
Safety Sign Co.
Signboards Flash Car Speed
 ✓ **To Aid Safe Driving**



Sign tells driver his speed at approach to junction

Pioneer Dr., St. Paul.
 Roadside signboards that warn the passing motorist of his speed near dangerous points on the highway are lending a hand toward safer driving. The sign is operated by two detectors, either magnetic or photoelectric cells, placed along the road ahead of the sign. As a car passes the first detector an impulse is transmitted to light up the sign. The second detector, 36 feet distant, sets mechanism in motion to compute the speed of the car between the detectors, and the result is flashed on the sign. If he is traveling too fast the driver invariably slows to a safe speed. Made in several designs, the sign may be used at approaches to intersections, railroad crossings, dangerous curves and hills, or at city limits.

L 1077

"Lifetime" Ink Pad Fed by Wells
 ✓ **Is Sealed Against Drying**

Sealed automatically by 140 tiny ink wells that open only when a stamp is pressed against the surface, an ink pad,



Pad keeps ink sealed until it is pressed by stamp

48

Thomas Sales Co.
321 N. Central Ave.
Chicago

Lev. at miniature scale
Agricultural School
 designed to last a lifetime, prevents evaporation of ink and keeps out dirt. As the surface is flexed by the stamp, the wells feed ink to moisten the stamp. Ink added through a rubber filler enters small cup-like openings that form reservoirs for the wells. The base of the pad is of rubber.

L 1029 ~~and irrigation meter~~

Electric Moisture Meter in Soil
 ✓ **Tells When to Irrigate**

W. M. W. & W. C. W.
 Sugar beet growers around Fort Morgan, Colo., use electric moisture meters to determine when to irrigate their crops and how much water is needed. Three-inch plaster of Paris blocks in which electrical connections are embedded are placed permanently in the soil at the start of the crop year. These blocks absorb moisture or release it just as the surrounding soil does. The electrical resistance between the terminals in the blocks, varying with their moisture content, is measured by a special instrument and the farmer can tell quickly whether irrigation is required.

L 783

Compass and Gauge for Brush
 ✓ **Guide Drawing of Circles**

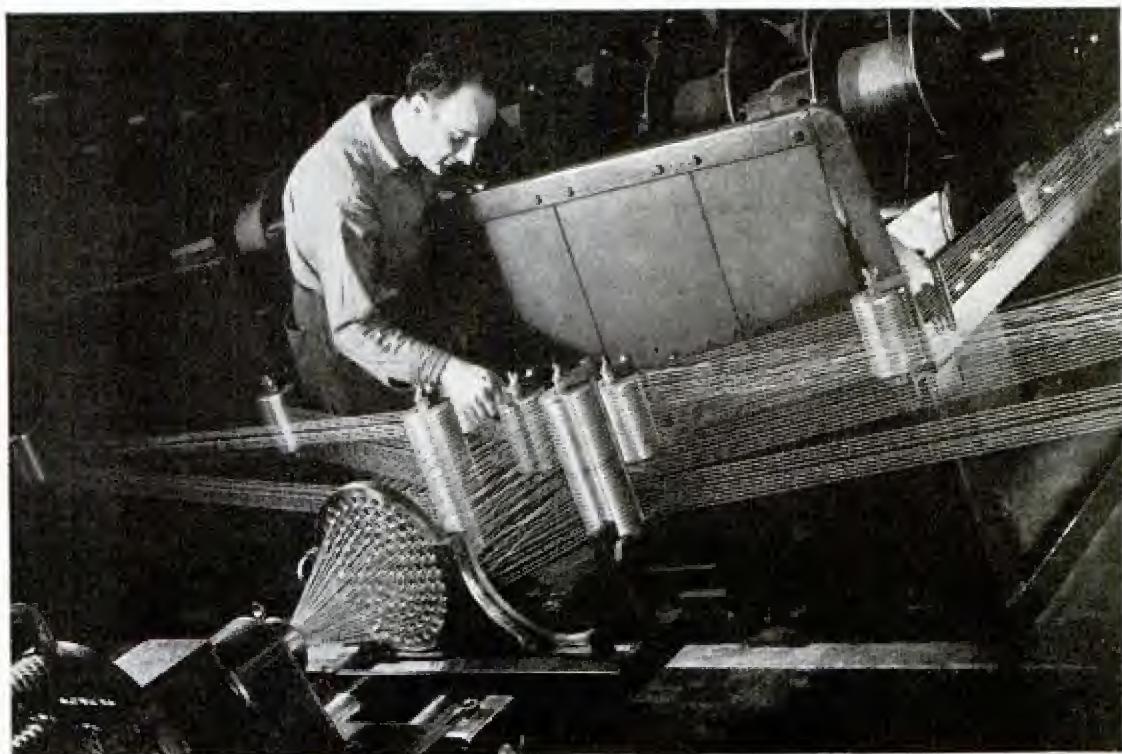


The brush draws a circle with a smooth, even stroke

W. M. W. & W. C. W.
 To guide a brush or pen in drawing circles, curves or straight lines there is a combined brush holder, compass and gauge. It has an adjustable guard by which light or heavy pressure can be supplied, thus keeping the brush stroke even around the circle.

1085

Wires "Poured Through Funnel" to Make Cable

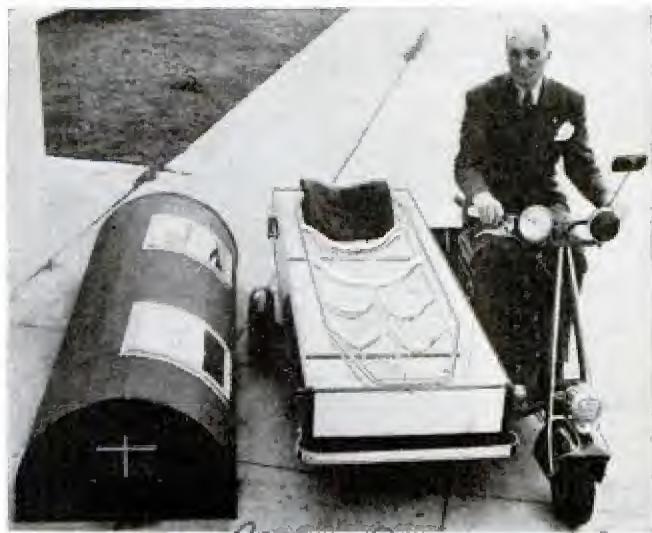


Wires from 101 spools form cone as they are concentrated into cable after passing perforated disk

Fed into a "flier-strander" at a speed of 600 feet per minute, 101 pairs of paper-pulp insulated copper wire, which may vary from 22 to 26 gauge, are formed automatically into a telephone cable, at the Kearney, N. J., works of Western Electric Company. The individual strands come from 101 supply reels holding about 25,000 feet

each and having individual motors to drive them. Sensitive tension control insures uniformity throughout the cable and guards the insulation against damage. At the end of the run the strands are passed through a perforated disk and into a funnel-shaped guide which gathers them into a compact "rope" for the finished cable.

1018 195 Broadway New York Scooter With Ambulance at Side Has High-Powered Motor



JANUARY, 1942

Press Assn

mid. States

134

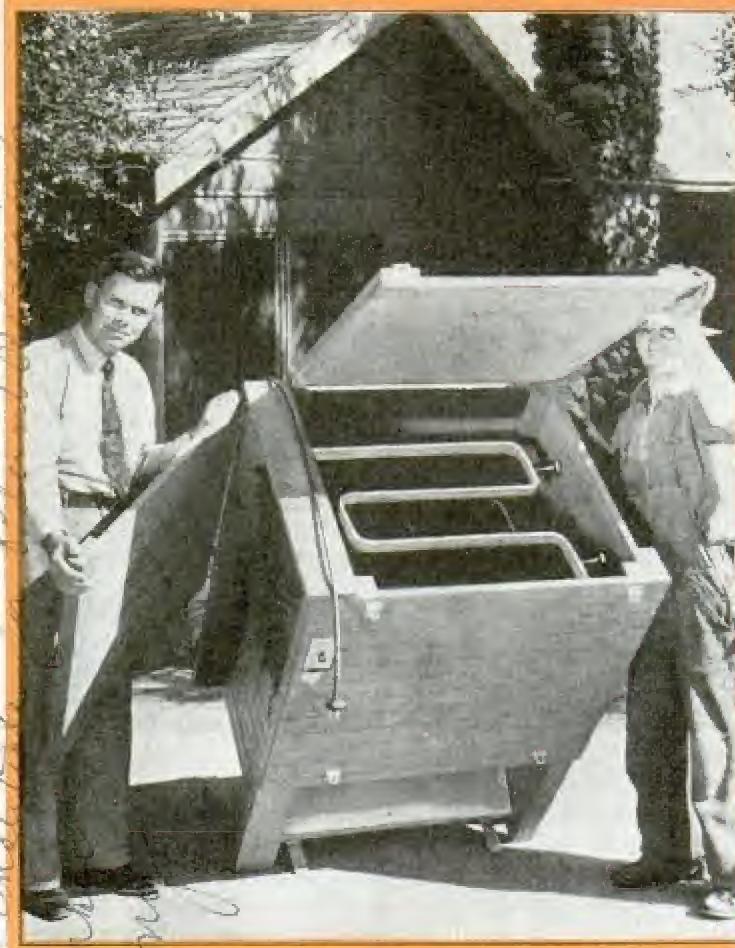
Distributor, ch. 49
n. La Salle. Chicago

Top is easily removed from ambulance mounted at side of motor scooter for speed in carrying casualties to treatment centers

Illustrator, ch. 49
n. La Salle. Chicago

L 1117 Legend

GROWING 'EM FASTER UNDER



Heating cable and a thermostatic control are being installed in this greenhouse bed to stimulate plants



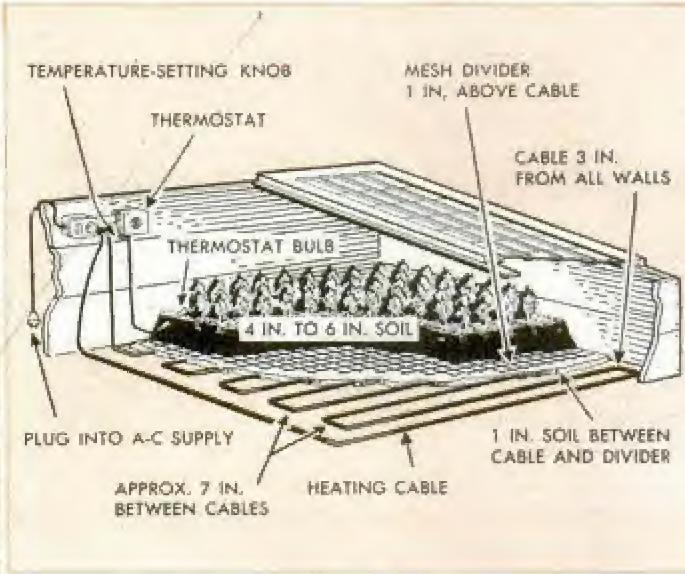
Tilted to show its interior, half-cubic-yard electric soil sterilizer is equipped with 3,000-watt units

FOR the amateur horticulturist anxious to continue "growing things" in winter, or perhaps to surprise his neighbor with out-of-season flowers, electricity holds amazing possibilities.

Artificial light produced by the ordinary tungsten filament lamp can work wonders on plants in the basement, the backyard greenhouse or hotbed, a glass-enclosed porch and even in rooms of the home. On some plants it will hasten blooming, increase the number of flowers per plant and increase stem length and size of flowers; on a few other plants, particularly chrysanthemums, it may be used to delay blooming.

Other electrical equipment, such as soil heaters and soil sterilizers, offers additional means of stimulating and controlling plant growth.

This sectional drawing illustrates how a hotbed is equipped with a General Electric soil-heating kit



LIGHTS

Costs vary widely, depending upon the interest of the amateur. A 150-watt lamp in a reflector, suspended two to three feet directly above the soil in boxes or pots in the basement or small greenhouse, will serve an area about three feet in diameter. Lamps of the same size may be added for larger areas, but 200 to 500-watt lamps are recommended—for economy in operation—if the grower desires to experiment extensively.

The large lamps, also in reflectors, should be mounted a greater distance above the soil and installed so that they may be raised as the plants grow.

Plants may be kept alive by artificial light in the neighborhood of 10 to 25 foot-candles—a 25-watt lamp in a standard reflector gives about 10 foot-candles on a nine-square-foot area when mounted two feet above the plant bench—but healthy and accelerated growth requires generally upward of 500 foot-candles. The larger lamps, being more efficient, are more economical for such work.

Operating costs vary, also, but the amateur may figure roughly on the basis of

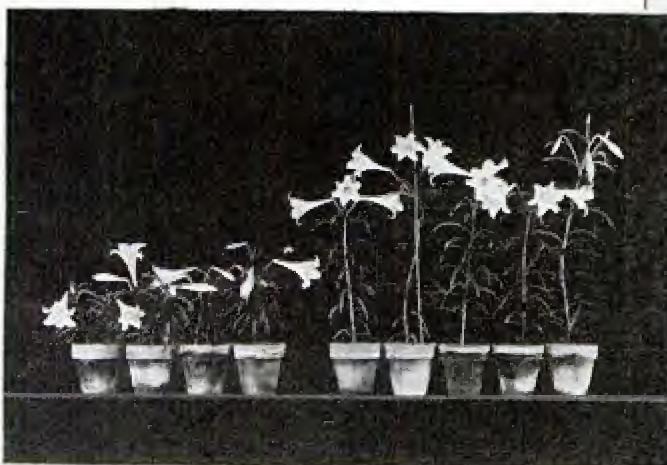


↑ Lamp and one type of reflector used to promote the growth of plants

↓ Floor lamp with pots for plants that grow well under electric light

Photo courtesy Lightalier, Inc.

Merchandizing New Ideas



These lilies furnish an example of the striking contrast in growth between "untreated" plants and those stimulated by light or heat. Horticulturists, amateur and professional, push plants into lovelier bloom and growth at desired season in this way



A housewife uses the oven to sterilize soil for flower pots

using 10 to 50 watts per square foot of soil and then calculating the burning hours, possibly three to nine* hours daily, and multiplying by the cost of electric power.

Things the amateur must watch are overheating and soil drying. This means frequent and careful watering or an automatic wick that will supply moisture, plus care

This plant-stand table lamp holds two vines; the upper, nearer the light, grew three times as fast

in keeping the lamps fairly well removed from the seedlings unless the atmosphere be cold.

Plants that bloom in midsummer do so on account of the long daylight period; these are known as long-day plants. In general they can be stimulated with artificial light to hasten blooming. Among these are: aster, to which about two foot-candles of light should be applied in the seedling stage; snapdragons, bachelor's button, sweet sultan, Chinese forget-me-not, larkspur, lace flower, dahlia, candytuft, delphinium hybridum, hydrangea hortensis, gardenia veitchii (temperature must be kept low) and pansy. Most respond to 15 foot-candles of light. The rose also may be stimulated, but the light must be of high intensity, on the order of 800 foot-candles.

Plants that normally bloom in the spring or fall do so on account of the shorter hours of daylight, and these are known as short-day

plants. Their time of blooming may be controlled by artificial light; thus, chrysanthemums can be forced to flower at Christmas instead of in October by extending the natural daylight period with light from electric lamps. Other short-day plants include poinsettia, begonia melior, freesia hybrida and euphorbia fulgens.

Attendant replaces light bulb in a greenhouse fully equipped with rows of growth-promoting lights



Courtesy A. F. Amling, Maywood, Ill.

POPULAR MECHANICS

2900 W. North Ave.

MICHIGAN ASSOCIATION OF ADVERTISING PUBLISHERS

2117

Just how much will artificial light speed up plant growth? In one test, in which 16 foot-candles of light were used 10 hours per night, the average decrease in the number of days from seed to flower was 28 days for American branching phlox pink (aster), comet type dark blue (aster), early royal purple (aster), snapdragon, dahlia, Shasta daisy and a few others. Pansies (Swiss giant blue), irradiated 10 hours a night under 1.5 foot-candles for 83 days, showed an 830 percent increase in flowering; and a 40-day reduction in time resulted from treatment of Heart of France asters with low-intensity light. Scabiosa responded remarkably, with a saving of 78 days in flowering.

In general, 10 foot-candles for four to six hours per night should be the minimum supplied to plants which show a definite response to light. Once lighting is started it should be continued every night until the plants bud and the stems are as long as desired.

Columbus Club

At Ohio State University, a portion of an unlighted basement was partitioned off with heat-insulating walls and lighted with tungsten filament lamps. Forced ventilation, controlled by thermostat, was used, with air brought from outdoors. It was found that plants could be grown very successfully in this basement room—a result of interest to the home owner who does not wish to go to the expense of building a greenhouse, but who would like to raise flowers during the winter.

Similarly, many glassed-in porches seldom used in winter could be converted into greenhouses at relatively low cost. All that is necessary is to install two or three thermostatically-controlled 500-watt lamps, in reflectors, put plants under them and have the fun of watching them grow.

Growth of plants in the home can be stimulated to a surprising degree. Usually these plants rely for their existence on natural light from windows together with what artificial light is available. In many cases the average light intensity will be under 10 foot-candles, or below the minimum for plant response. So the home owner should increase the light intensity. To grow plants away from the windows 100 to 300 foot-candles will do a satisfactory job. Even those plants near windows will be benefited by artificial light four to six hours during the evening. Many vari-

(Continued to page 180)

JANUARY, 1942

2118

Athlete's Shatterproof Visor ✓ Protects His Glasses



This transparent shield protects athlete's glasses

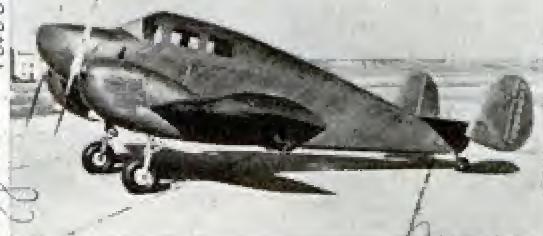
For the protection of athletes who wear glasses there is a new visor made of highly transparent and shatterproof Plexiglas. Recommended for basketball, squash, handball and similar games, the visor consists of a single curved sheet of Plexiglas supported against the forehead and cheek by sponge-rubber pads.

2109

Plane Body of Plastic Plywood ✓ Is Inexpensive to Build

Made from inexpensive materials not restricted by defense preparations, a plane molded of plastic plywood offers possibilities for mass production and bids fair to become the airplane of tomorrow. There are no nuts or bolts in the body, all parts consisting of various layers of mahogany sealed with a secret plastic composition under heat and air pressure. Mounting two 65-horsepower engines, the ship has a top speed of 142 miles an hour.

2110 *Shrop Cheay*

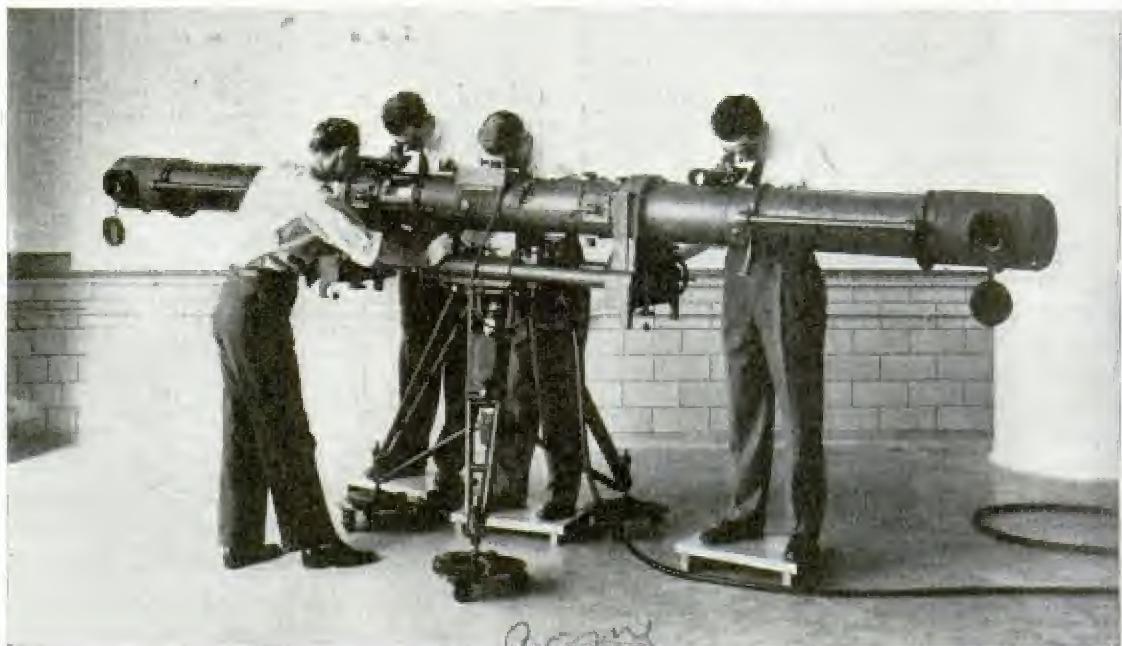


Plastic airplane body lends self to mass production

*Lanley Aviation Corp
30 Rockefeller Plaza*

L1107

Stereoscopic Finder Shows Height of Airplane



Anson

Four men are needed to operate stereoscopic finder that tells antiaircraft battery height of plane

Antiaircraft gunners of the U. S. Army have a new stereoscopic instrument which helps them determine the height of enemy planes. Delivered recently by Eastman Kodak Company to the Ordnance Department,

Worcester, Mass.

ment, the height finder, which needs four men to operate it, indicates the correct gun elevation and setting of shell fuse when it is sighted upon a plane. Mounted on rollers, the horizontal tube is easy to maneuver.

Defense Material From Rubber Is Aluminum Substitute



Aluminum

Made largely from rubber, a stiff plastic sheet, one-third lighter than aluminum, can be used in place of that metal in self-sealing, bulletproof fuel tanks for military planes, tanks and scout cars. The new product has been announced by Goodyear Tire and Rubber company, which calls its material Plioform. The United States Rubber company announces a product with somewhat similar properties which is designated simply as Formula C-102. The fibrous substance developed by Goodyear has qualities surpassing aluminum as a shell for the fuel tank in resisting

Notice how bullets ripped aluminum, left, compared with Plioform, right

leakage when hit by bullets. If machine gun bullets "tumble" while passing through aluminum they tear the metal in a way that often holds open the punctures made in the inner selfsealing lining. The nonmetallic material is less vulnerable because it does not flare under gun fire, gives maximum support to the lining and will not burst if the plane crashes.

L1005
**Self-Supporting Ladder
✓ Stands Clear of Car**

Suitable for many uses in the home or shop, a handy ladder stands upright on a special base without leaning against anything



The Inventor E. 1551 W. Liberty Ave. Milwaukee, Wis.
for support. When used in cleaning or polishing the car, the ladder enables one to reach the entire top from one side without moving the ladder. It cannot mar or scratch the finish because it makes no contact. Capable of supporting up to 1,500 pounds, the all-steel welded ladder resists tipping over or moving when bearing weight. Used in pairs, they make sturdy supports for scaffolding. The base is detachable for compact storage.

L1081
**Knock-Down Shelves in Kit Form
✓ Ready to Be Assembled**



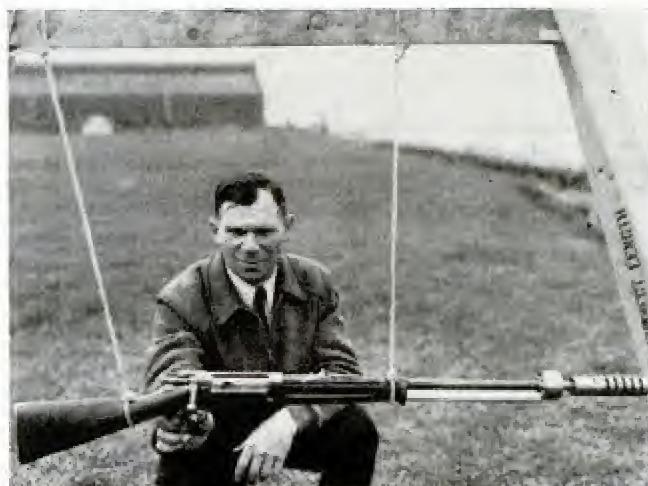
Carrison Pine Scotch & Cedar
Slots cut in shelves and side panels simplify their assembly

Ready made and easily assembled by the purchaser, shelf racks for hanging on the wall or for use as corner shelves and attractive what-nots are now available packed in kits. Made in two, three or four-shelf units, the pieces are cut for ease in fitting them together, being unpainted so the owner can stain them to his liking. They may be taken apart quickly for moving or storing them.

L1026

**Tube Mounted at End of Rifle Barrel
✓ Takes the "Kick" Out of Gun**

Army ordnance officers are said to have been favorably impressed with tests of a rifle barrel attachment that reduces the "kick" of firing to a mere quiver. Invented by Edward W. Renick, of Kenosha, Wis., the device is being adapted also for use on machine guns.



To test its "kick" gun was fired while suspended by two ropes



MARCHING ON WHEELS

Army trucks of the 4th Division, motorized, at Fort Benning, Ga., roll across the horizon on "dawn patrol"

Photo by Harlan Walker

DO-G TIRED after 48 hours in the field under battle conditions, the 15th Infantry, U. S. A., didn't expect an "alert" when it returned to camp in central California. But emergency orders were there.

"2nd Battalion, prepare to leave Initial Point at 8 p.m., reach March Field at 8 a.m.; 1st Battalion, prepare to leave Initial Point at 9 p.m., reach Ventura at 6 a.m.; 3rd Battalion in reserve."

Two thousand men with their full field equipment, tentage, machine guns, anti-tank guns and mortars, extra ammunition and rations, and military baggage down to the last typewriter, had three hours notice to prepare to move 250 miles overnight. Already the plans-and-training officer was preparing the written orders, route maps, and march tables. Reconnaissance parties had started south and extra troop carriers were being dispatched from other regiments. March unit commanders synchronized their watches.

At eight o'clock the first serial of 100 trucks, split

into three march units spaced five minutes apart, was moving out onto the highway. Road speed was 25 miles per hour. With a 50 yard interval between vehicles, the column was five miles long. The drivers used their headlights, not the shuttered blue "black-out" beams that they would switch on in a real emergency.

Individually, the drivers could travel at twice the ordered speed but the moderate rate was fast enough to cover ground and still allow civilian traffic to flow past safely.

See Mar 1942 - 81



Antitank gun and crew pass a line of tanks and trucks on a country road during maneuvers



A tank company parks on the "shoulder" of paved highway while awaiting the order for the advance

Going through towns, each march unit closed up, almost bumper to bumper, and was convoyed through traffic by civil police that the reconnaissance parties had warned. On hills and curves the column lengthened out because of the different gear ratios and acceleration rates of the various types of four and six-wheel-drive vehicles. Little 500-pound "blitz buggies" can climb hills faster than the big personnel carriers loaded with 20 men,



On the roof of a troop-carrying truck a machine gun points its nose skyward, ready to fight off aircraft

Ten big tires on this trailer support the weight of the heavy field gun, which can go places in a hurry

U. S. Army Signal Corps photo





Carol Browning photo
Here's the covered wagon of the 1940's: a unit of the 129th Infantry in fatigue uniforms starts for the field in a tarpaulin-covered truck. These troop and supply carriers have to be tough. In maneuvers and in war, hills they encounter will not always be paved like this.



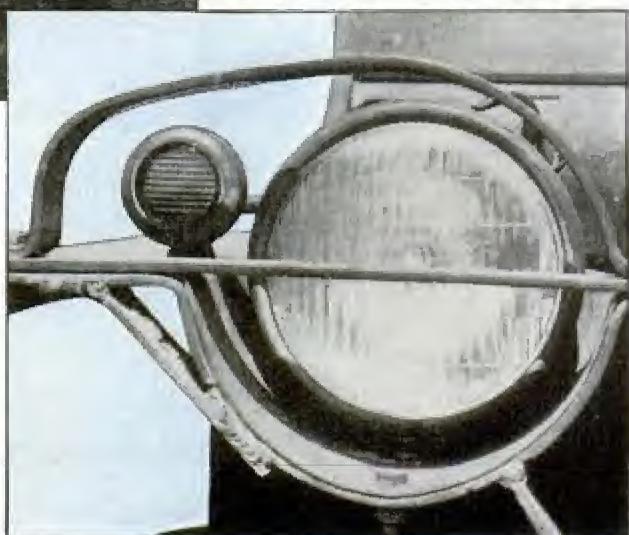
and a command car has more reserve power than one of the service trucks with its load of spare parts or repair equipment.

Ten years ago, for such a trip, the soldiers would have had to wait until train schedules could be revised and a troop train made up, or they would have had to hike the distance at 15 or 20 miles a day. Motorized, they go where they are needed, on their own schedule. Trains are faster but more vulnerable to damage than are trucks that have the choice of several routes and can move around destroyed areas.

The modern streamlined infantry regiment is not entirely motorized nor at the moment is it ever expected to be. The some 200 vehicles attached to a regiment are for scouting, hauling ammunition and baggage, for use as ambulances, and for other special purposes. The bulk of the men march on foot. But in an emergency the entire regiment marches on wheels, in big 1½ and 2½-ton trucks. The 1½-ton kitchen trucks and trailers are spaced in the centers of the march units and the cooks prepare meals while the column is moving. A regiment can halt, eat, and be on its way again in half an hour. Drivers spell each other at two-hour intervals. There are periodic halts to inspect the motor equipment and to rest the men. In bad weather the big personnel carriers are halted until canvas tops and sides can be unrolled.

The trucks can go more than 200 miles on a tank

"Blitz buggies" carry a small shielded blackout lamp attached alongside the ordinary headlight





of gas and each vehicle also carries extra fuel to be placed in the tank at the noon halt. One of the duties of the reconnaissance party that precedes the column is to pick out the camp site where the motorized outfit will spend the night and to arrange for several fuel tank trucks to be on hand. The army trucks gas up, check water, air, and oil, and are prepared for the road again before they are parked for the night. If danger from aircraft is being simulated the trucks are camouflaged and parked under trees, or if the camp is in open country the trucks are scattered over a wide area.

The flow of ordinary traffic plus road conditions sometimes tend to disrupt schedules but the job of each column is to reach its destination on time, as a unit. Control points are established on the route maps and the march units are checked

U. S. Engineers threw this pontoon bridge across Chattahoochee river in 41½ minutes. Front truck carries foot bridge units

Exploits of these "blitz buggies" have become almost legendary in the army. "Back seat driver" mans a machine gun



*Headquarters Co. 4th Division
at Panama City Florida*



Headquarters company of 4th Division lines up at field kitchen, mounted on 1½-ton carrier



15th Infantry's human signpost points road. Sign means 4th march unit passed at 2:30 p.m.

off as they pass these points. Vehicles that have engine or tire trouble fall out and catch up with the tail of the unit after repairs are made. Guards are posted at railroad crossings. Guides are stationed at important turn-off points. Each guide wears a blackboard across his chest, on which he chalks the time that the tail of the last march unit passed his post so

that the leader of the following unit will know whether to speed up or slow down to maintain his five-minute interval.

From his command car the leader of the serial maintains close control of his column by motorcycle messengers, radio, and by observation planes. Messages may be dropped off at the guide posts to be delivered to the march units behind. On extended trips that may require several days, an airplane is used to check over the miles of vehicles, spotting the head and tail of each march unit by the white stripes on the tops of the leading and rear trucks, and reporting the positions to the serial commander by radio. The portable "walkie-talkie" radio is used also for communication with one of the command cars which is fitted out as a mobile radio station.

Radio operator is in foreground, gunners at rear of scout car



2751

The brunt of modern fighting is borne by mechanized equipment. Tanks, as well as troop carriers and guns of all sizes mounted on rubber-tired wheels, can maneuver across rough country near the scene of action but to get there fast the vehicles must have improved roads. Fortunately, civilian highways cover every part of the United States. More than 75,000 miles of our road system have been designated as a strategic military highway network. Parts of this network are modern four and six-lane superhighways that have been built to army specifications. Such highways can support heavy military traffic, including the great prime movers that tow 155-millimeter field guns at 50 miles per hour.

State highway engineers are busy widening and strengthening bridges, reducing curves and grades, and increasing the width of parking shoulders along the older portions of the strategic routes. California, for example, with 1,000 miles of sea coast, has 7,000 miles of highway in its strategic system and is spending \$150,000,000 for additions and improvements. Access roads that will tie air fields, training centers, and defense manufacturing centers directly into the network are also being improved.

In many instances, highway engineers have considered military necessity as well as existing traffic needs in laying out new routes.

A road leading down to a beach, now thronged with week-end traffic, may have been planned and built with the knowledge that it may sometime serve to rush troops and guns to a threatened spot. Coastal highways that are famous for their scenic views "happen" to have curves, grades, and fields of view that are suitable for big mobile guns. Built primarily for business and pleasure vehicles, our highway network is also a network for defense.

96-Million-Volt Atomic Bullets Equal Cosmic Ray Power

Atomic bullets equal in power to some cosmic rays have been produced with the 225-ton cyclotron at the University of California. The bullets of 96,000,000 electron volts were six times more powerful than any previously developed by man. Even these, however, will be dwarfed when the new cyclotron at Berkeley, Calif., is put into operation, for it will launch carbon bullets of 600,000,000 electron volts.

JANUARY, 1942

Mr. & Mrs. J. C. L. & Co.,
Berkeley, Calif.

Painter in Mask and Hood

Sprays Railroad Cars

✓ Sam W. Kelly Jeannette Pa.



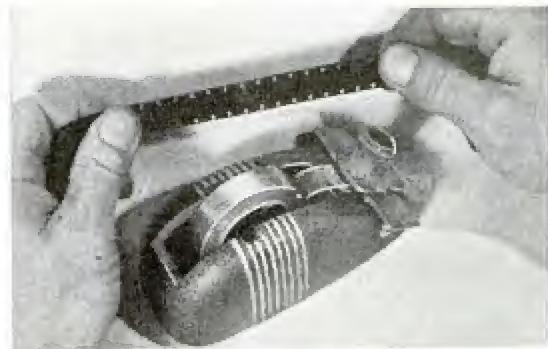
Sprayer keeps paint off himself with hood and mask

Hooded workmen wearing respirators operate paint spray guns at the Pitcairn, Pa., shops of Pennsylvania Railroad, where thousands of new cars are being constructed and old ones reconditioned. Paint used on the cars has an oil base, instead of lead, and therefore is not injurious to the health of the painters.

21069

Transparent Tape Saves Movies By Splicing Film at Tear

Torn motion picture film in the 16-millimeter size can be mended in one operation with a splicer that uses transparent cellulose tape. The torn edges of the film, fitted together in their original positions, are held firmly while the tape is applied.



Transparent splice saves loss of frames at the tear

L. J. Brothers 61
542 N. Wilcox St.
Los Angeles
MICHIGAN 4-12222

2-1959 Cont. Marshall Perkins Los Angeles
1138 Years Ago

GETTING DINNER *the HARD WAY*



From the South Seas to Santa Catalina Island, off California's southern coast, has come one of the world's most dangerous and adventurous sports, a dawn to dusk boar hunt, tuna "shoot" and roast called by its Polynesian name, "luau." The wild boar hunt is always packed with thrills, for often the hunter becomes the hunted. A wounded boar usually charges, sometimes plays possum; the hunter above has his pistol ready for any surprise attack.



↑ This four and a half foot boar wasn't so big, but he was packed with dynamite

← Angered by one shot, a boar takes after the horses like a hurricane on hoofs. Luckily a sharpshooter is drawing a bead

Bringing back these savage boars alive tops 'em all for excitement. Veterans with cattle-roping experience toss lariats simultaneously over head and hindquarters. If one misses, it's tough for the other





A perfect hit like that above comes once in 100 shots. At right, preparing the luau feast. Fire is built in a pit three feet deep; volcanic rocks are heated, and these are stuffed inside the pig. It is wrapped in banana and palm leaves, surrounded with tuna and yams, the pit is covered with leaves, then wet burlap, and boar, fish and yams are cooked three to five hours

While one group of huntsmen armed with rifles, revolvers and lariats face Catalina boars with four-inch tusks, others go to sea to hunt tuna in Robin Hood style. Up to 20-pound tuna are shot with 30-inch arrows with two-way swivel point that spreads with a tug on the line, making it hard for the fish to escape. For larger tuna, sea bass, albacore and marlin a three-way swivel point is used. Above, a marine Robin Hood takes aim. Archer at upper left has scored a bull's eye on a fish close to surface. It's not often possible to land a hit good enough to play the fish on a line without risking its loss.



Space-Saving Dinette Table Folds to Small Cupboard

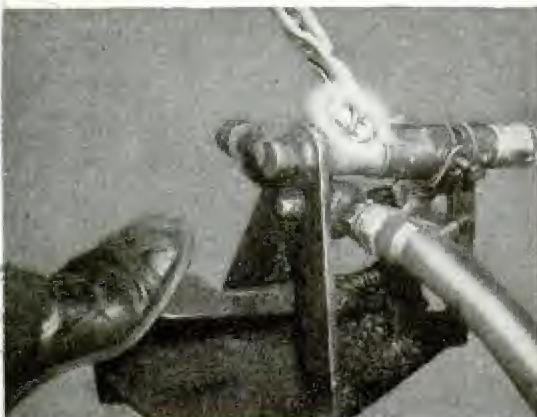


Table seating six persons folds as shown in inset

Forming a slender cupboard and chest of drawers when its side leaves are dropped, a gateleg dinette table not only takes little space but provides a place to store linens and tableware. When opened into a full-size table seating six, the leaves are supported by gate legs that operate easily. The cupboard and two drawers are accessible in both open and closed position.

Red-Hot Rivet Shot Through Hose By Compressed Air

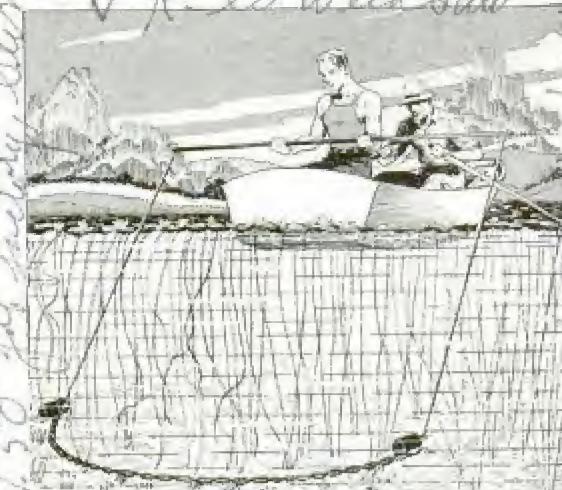
Replacing the old method of tossing rivets, a pneumatic conveyor shoots red-hot rivets 300 feet through a heat-resisting rubber steam hose at high speeds. Used at



Stepping on treadle speeds red-hot rivet to riveter

shops of the Louisville & Nashville Railroad in South Louisville, Ky., the conveyor system permits rivets to be shot around corners and to places where it would be difficult to throw them by hand. One rivet heater can supply three widely separated riveters at the same time. The heated rivet is placed head-first in a slotted metal tube coupled to the hose. Pressure of the operator's foot upon a pedal then slides a jacket over the rivet, enclosing it effectively, and simultaneously releases compressed air. Under this pressure, usually about 85 pounds to the square inch, the rivet darts speedily to its destination, dropping into a "stopping cup" from which it can be removed and applied immediately. Any size rivet can be handled, provided the hose and conveyor gun are the proper size.

Submarine Saw Clears Seaweed In a Channel Ten Feet Wide



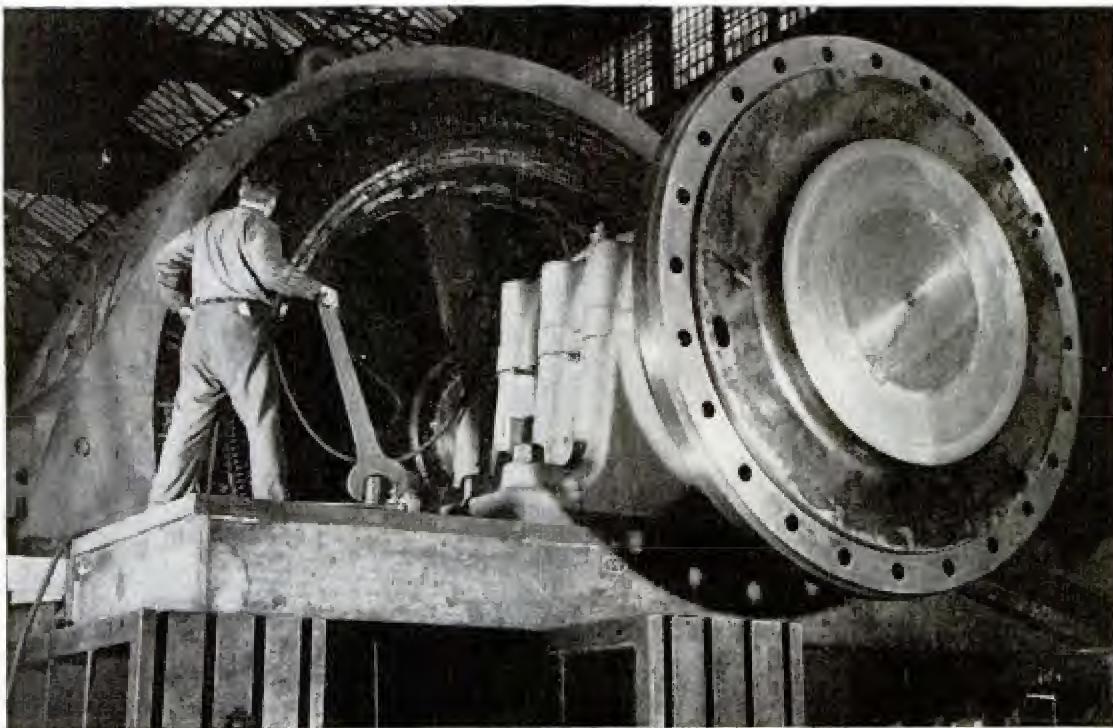
Saw blade manipulated along bottom cuts weeds clear

Weeds can be cleared from a lake or river bottom in a channel ten feet wide by manipulating a saw from the stern of a rowboat. The 14-foot saw blade is double toothed and spiral so that a cutting edge always faces forward. Sinkers keep it on the bottom, and at the top it is spliced to the ends of a 10-foot operating pole. While one person rows, the other gives the pole a sawing motion and the weeds, cut close to the roots, float to the surface.

Write to the firms listed in the Where-to-Buy-It index, page 4-A, to learn more about products described in this magazine. Say You Saw It in Popular Mechanics.

21030-

Largest Electric Motors Power Aluminum Mill



Testing a 5,000-horsepower motor at Westinghouse plant before it was put to work rolling aluminum slabs

Two 5,000-horsepower electric motors, the largest ever built, have been installed in the Alcoa, Tenn., plant of the Aluminum Company of America to drive the eight-

foot mills which will roll aluminum ingots into slabs. Continuous mills then will roll the slabs into the sheets required for airplanes. Each motor weighs 480,000 pounds.

2994

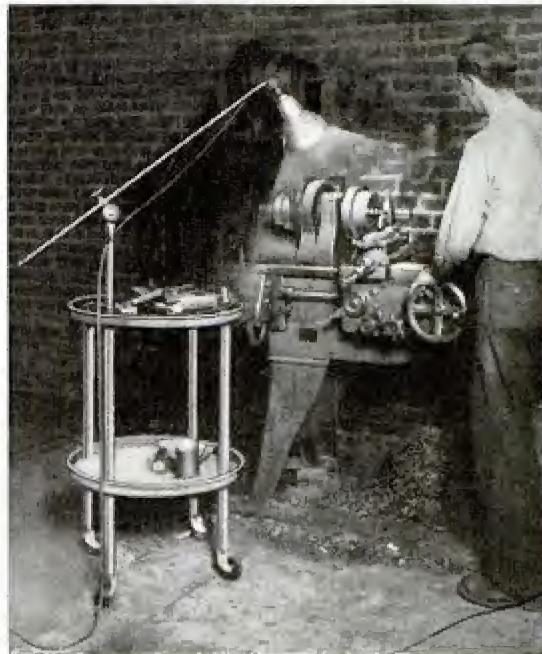
Portable Tool Stand Has Work Light on Extension Arm

Equipped with two trays for holding tools and spare parts, a "shop helper" on wheels has an extension light to illuminate work wherever it may be used. A reflector and the lamp are suspended on an adjustable arm, and the cord may be plugged into any outlet. A braking system permits the stand to be steadied so it will not move about easily while it is in use.

21032

Sulphur Spray Is New Weapon In War on Garden Pests

Experiments with a new organic sulphur compound indicate that science has found a powerful weapon against the Japanese beetle, as well as against fungi that attack plants. The chemical, known technically as tetramethylthiuram disulfide, partly paralyzes the forelegs and mouth of the beetle, and one part of the compound to 30,000 parts of water will kill the spores of barley smut fungus.



Lamp on rolling tool stand may be adjusted as needed

Denver Electric Motor Co. Chicago
2933 N. Van Buren, Chicago



Going far to the right for a corner shot. With good foot-work you can cover wide territory without loss of balance

A forehand chop shot is just taking off. Notice how the bat has already cut through the ball, imparting a spin



By Don Harris *(as above)*

Former California Doubles Champion

NO MAN is ever more bewildered than the average table tennis player the first time he encounters an expert. The novice seems unable to do anything right, and he cannot fathom the reason. One of his returns will fly clear off the end of the table, another will plunge into the net, or the ball will miss his bat entirely.

There was no reason, so far as he could see, why the ball should behave thus! But reason there was. He was beaten by superior skill, the rules of which are easy

TIPS on TABLE TENNIS

Here is the backhand side of the recommended grip. Thumb is extended on opposite side



POPULAR MECHANICS

to learn, the mastery of which is only a matter of practice. Let's look at them.

First essential is proper grip on the bat. Place your hand just as if you were "shaking hands with the bat." That is, grip it fully and firmly, with the handle clear into your hand, the index finger extended straight across one back corner surface, the thumb extended on the other side.

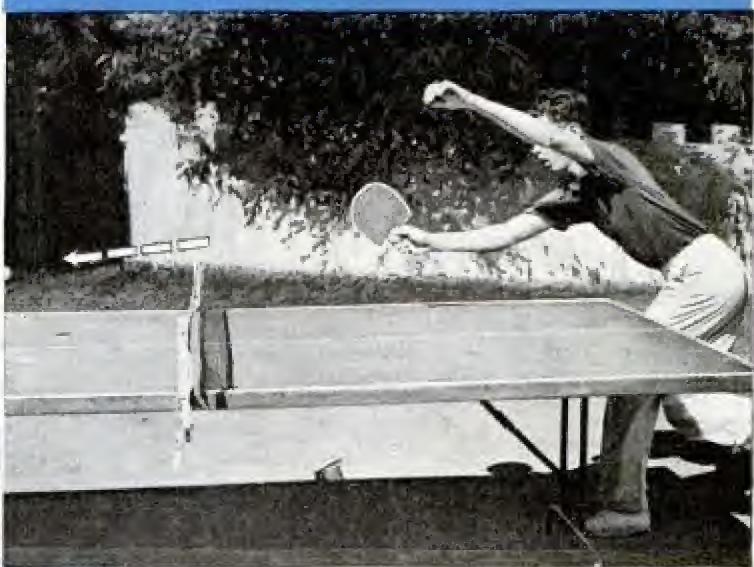
Another grip considered acceptable, but rather out of date, and not so effective, is the "penholder" grip. The thumb and index finger are passed around the handle, and joined in front, while the other three fingers are extended on the back side to provide steadiness. With this grip only one side of the bat is used, and players who use it are generally character-

Oldfashioned penholder grip is acceptable but backhand is weak; one side of bat is used

PENHOLDER GRIP



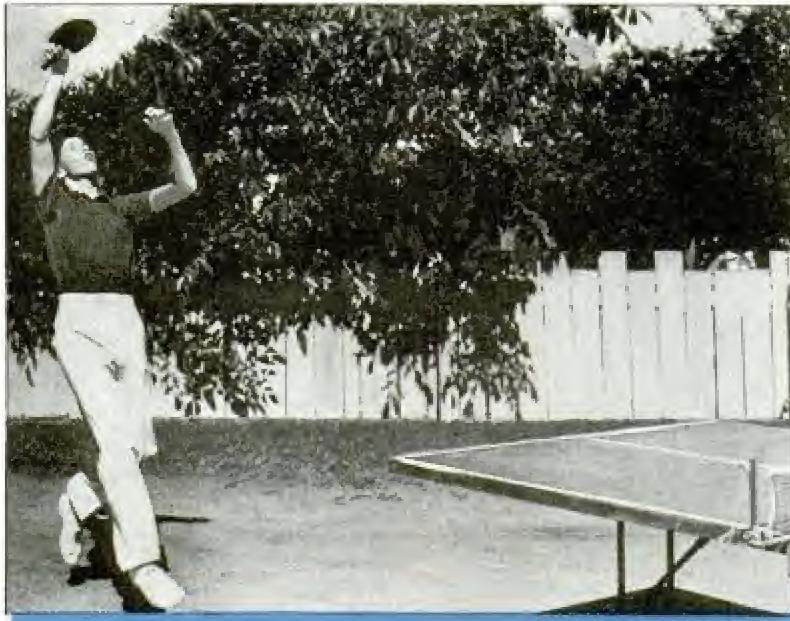
Above, rushing forward with good footwork and balance to recover a drop shot. Below, the shot is on its way, the player has recovered equilibrium and is ready to step back into position



ized by weak backhands. If you are using grips other than these, change immediately, preferably to the handshake grip.

Next in importance is stance. This should be taken about three feet behind the table, with both feet pointing toward the opponent, and spread about ten inches or a foot. When the ball comes, shift quickly to meet it, then shift back again. This requires good footwork. Get your feet tangled up, and you will wear yourself out hopping around, while your opponent drives shots out of reach.

The rules of footwork are simple. To go back to make a forehand shot, retreat on the right foot, and when going back for a backhand shot, retreat on the left foot. When going forward or to the side for a forehand, step with the left foot,



Leaping into the air to return a hard-driven ball that opponent endeavored to place too deep for the player to reach

crossing it over if you are going to the right. Going forward or to the side for a backhand, do the same with the right foot. With this method, one step will permit you to return a high percentage of shots, and maintain that all important balance.

Why, when you played that expert, did your attempted returns behave so crazily? What was he doing to that ball, bewitching it? Not at all. He was applying fundamental laws of physics. You can make the ball do those same tricks. There are only

This is the position just before bat hits ball in backhand drive serve. Bat starts several inches lower

two fundamental rules to learn, with variations for forehand and backhand. Champions frequently employ others but you can play excellent table tennis—indeed, tournament table tennis—if you master these thoroughly.

First is the drive. This is the method he used to make your returns sail clear off the end of the table. If you were watching closely, you may have seen him start his swing about a foot below the course of the ball, and come up to meet it, striking sharply at the last moment. Just a

straight, clean stroke, with good follow through.

When bat and ball met, the upward motion of the bat imparted forward spin to the ball, and sent it speeding low over the net. Just as a pitcher puts forward spin on a baseball to make it drop sharply, so he put forward spin on this ball for the same purpose. Consequently, just as it crossed the net, it dived sharply, striking the table before you expected. Then the spin caused it to bound along close to the

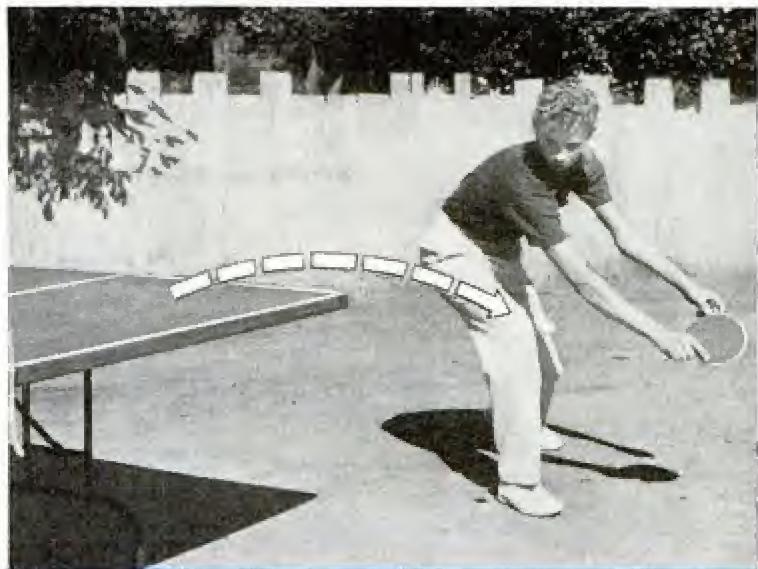
In this serve the bat begins the stroke with its top rim about level with ball, rising to meet the ball



table, and you dug your bat deep to be sure you picked it up. But that was the wrong thing to do, for the forward spinning motion still continued, and when the ball struck your bat, this gave it even more lift. These factors all combined to send the ball far deeper than you intended—probably clear off the table.

These drive shots, producing top spin, can be delivered either from forehand or backhand. For the former, start ten inches to a foot below the ball, and strike forward and upward. The name "drive" does not mean you must hit with all your force. Speed is desirable, but not at the expense of rhythm and balance. Nor do you have to twist your bat to provide spin; a good clean stroke, forward and upward takes care of that.

From this position the bat is stroked vigorously forward and down, imparting backspin to ball



Beginning of backhand chop shot with bat about ready to pass along under side of ball (above); the follow through (below)



FOREHAND CHOP SERVE



For the backhand drive, the bat is drawn around until the forearm rests against the waist, and from there it is delivered forward with a long, sweeping motion. The first part of the stroke should be parallel with the ground, then it should rise sharply just before the ball is struck, and the follow through should continue until the arm is almost straight.

To get the opposite effect of a drive, and cause you to dump the ball into the net, your expert used a chop shot. Where the drive shots cause the ball to sink, chops cause it to soar high; then, instead of diving, the ball stops short as it strikes the table, for it is spinning backward. This has two effects. First, it prevents you from hitting the ball as hard as you thought you would, and second, the spin drags the ball downward upon contact with the bat. Both combine to make a

(Continued to page 170)

✓ Nontilting Lifesaving Jacket Keeps Body Upright

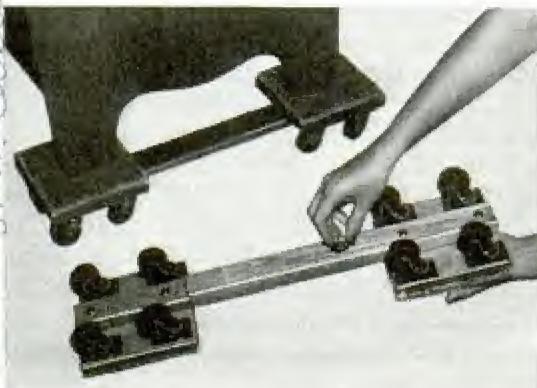


This lifesaving "harness" floats you with head up

Particularly useful in wartime for mine-laying, pontoon-building and rescue work, a lifesaving jacket put on like a harness permits the wearer to "stand up" in water. The inventor, Capt. Wm. W. Haupt, of Chicago, Ill., has offered the idea to the United States armed forces. He explains that its design maintains a low center of gravity, keeping the body upright. In testing the device one wearer was unsuccessful in attempts to upset himself, as the jacket returned immediately to vertical position with his head upward.

Eight-Wheel 'Skates' Used in Pairs Help Move Heavy Articles

Heavy articles such as stoves, refrigerators, boxes and filing cabinets can be moved by one man with the aid of a pair of



Dolly can be extended to fit rollers under corners

Reynolds Locomotive Co
2650 W. Congress Chica
skatelike dollies that adjust to various widths. He simply tilts the object and kicks the dolly under, then places another dolly under the opposite end in similar fashion. Dollies are equipped with rubber-wheel casters to protect floors. A model of extra rugged construction is available for hard use in a stock or shipping room.

2957

Automatic Control Stops Idling To Prevent Waste of Fuel

Waste of gasoline which results from letting the motor truck or automobile engine idle while parked can be eliminated by equipping the vehicle with an automatic control that stops the idling within 15 to 20



Extension on gear lever stops idling in neutral

seconds after the gearshift lever is placed in neutral position. Attached to the shifting lever, the device does not interfere with its use and will not stop the engine while the vehicle halts at a stop-and-go light.

2957

Sun Will Explode Far in Future, Turning Earth Into Gas

Although it seems certain that the sun will explode, according to Dr. George Gamow of George Washington University, the time this will occur is so remote that man of today need not worry about it. Dr. Gamow adds that in such an explosion the increase of solar heat would be quite sufficient to turn our planet instantaneous-

ly into a cloud of hot gas. On the sun, hydrogen is being changed into inactive helium, and Dr. Gamow's work has shown that the sun gets hotter as the supply of hydrogen fuel is used up, because the remaining fuel is burned faster. However, it has been estimated that the sun consumes about one-billionth percent of solar hydrogen per century, so it will be several billion years before the present amount will be changed enough to make human beings go into underground shelters to shield themselves from intense solar heat. And still more distant is the day when the explosion of the sun is expected to occur.

11002 One-Man 'Gasproof' Ambulance ✓ Driven by Bicycle Gear

Stretcher patients suffering from shock and in need of emergency oxygen treatment are given first aid in a man-powered ambulance while they are being taken to a hospital by the Home Guard in England. The vehicle attains a speed of 15 miles per hour, drawing in filtered air as it runs and supplying oxygen from a cylinder so resuscitation can be accomplished without the use of a respirator which may restrict breathing. A bicycle attachment at the rear is pedaled to propel the ambulance, the driver being in position to watch the patient through an observation window. The driving portion can be disengaged and the stretcher wheeled into a ward without disturbing the patient, who may remain within the ambulance if further oxygen treatment is required. With this carrier one man can load a stretcher patient and transport him, a task heretofore requiring the service of several persons.



"Bicycle" ambulance gives oxygen treatment on way to hospital

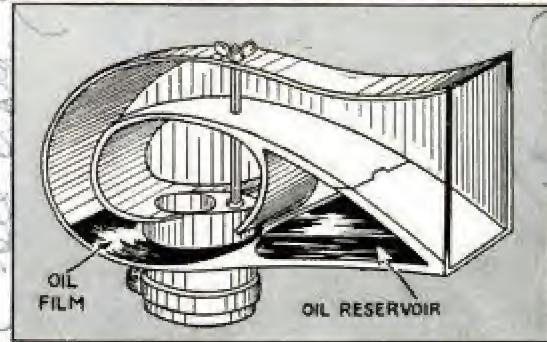
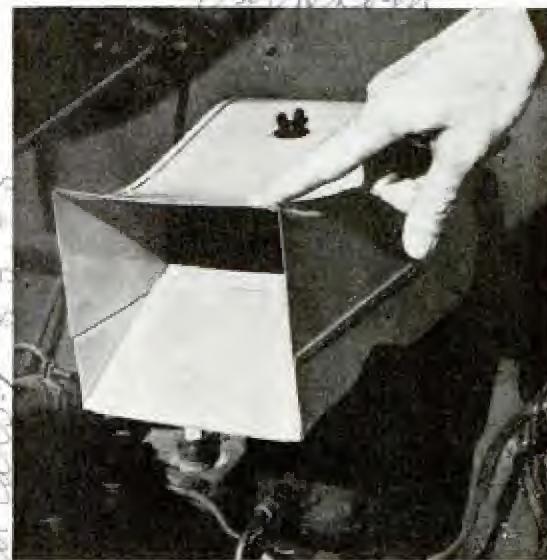
JANUARY, 1942

Rescue and Relief

V. B. C. Hospital

Laender, Anna Hospital

✓ - 254 "Supercharger" Easy to Fit Helps Power and Pick-Up



Wind from fan hits air cleaner, supercharging engine

Performing the service of a supercharger, an oil bath air cleaner that cannot clog keeps plenty of air above the carburetor so the engine has less work of pulling the air on the intake and all cylinders get an even, balanced charge for better performance. The "supercharger" is installed in place of the regular air cleaner, being fastened over the carburetor without drilling any holes. The manufacturer claims that by utilizing wasted air currents under the hood and putting a finer, richer mixture of gas and air into the cylinders this cleaner increases power, acceleration and gasoline mileage.

See index, page 4-A, to find where to buy articles described in this magazine. Say You Saw It in Popular Mechanics.

Leggett WARRIORS ON SKIS



Leggett
Here are the winter warriors preparing to fire a heavy machine gun that is transported over ice and snow on a toboggan. Training includes quick assembly of the machine gun

FLITTING like ghosts across the snow, whole battalions of the United States Army are mastering the art that enabled ski-shod Finnish soldiers to combat su-

perior Russian forces in the bitter cold of their northern Europe battleground.

A trained skier is at least four times as useful as the man floundering afoot through snow and icy crust. That is the lesson taught by the Finnish campaign and the lesson that our army is putting to good use. Almost invisible in his white camouflage suit, the ski warrior moves swiftly to strike the enemy at vulnerable points and to gather information of the enemy's movements. Technically, his is the role of a fighting scout for the main body of troops.

Parkas of colors to blend with the winter

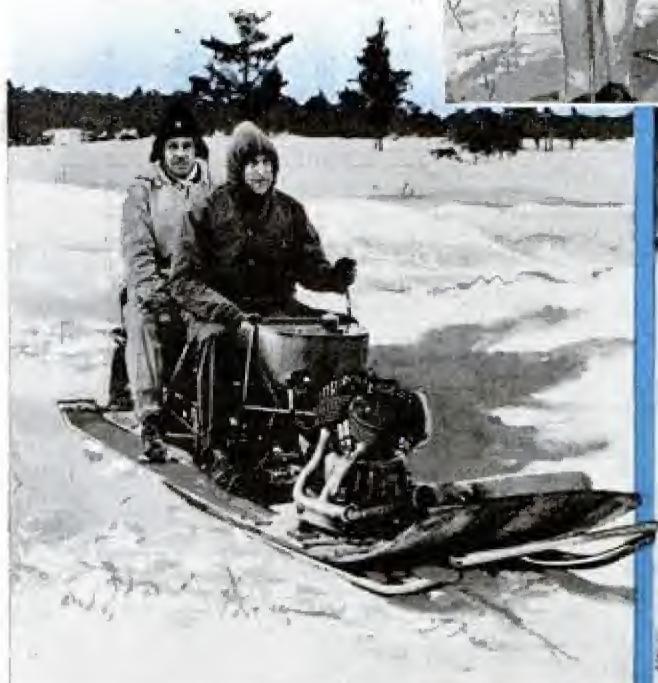


This is the way guns, ammunition and other equipment are transported—on a four-man sled—by the 26th Infantry Ski Patrol

Garbed in light clothing, riflemen on the snow are almost invisible to enemy observers at a distance

scene, skis of different lengths and poles made of metals and woods are being tested by the army in development of its fighting units on skis. Small shelter tents and sleeping bags are being used together to determine the best protection for fast-moving patrols forced to sleep in the open in sub-zero weather. Various types of winter clothing and rations dehydrated to prevent freezing are tried out. Machine guns, trench mortars and antitank guns, as well as other heavy equipment, must be transported over deep snow, so the ski soldiers experiment with hand

Ski troopers lined up and → ready to start on their cross-country patrol



Motor-driven sled (above) on a practice run. The U. S. Army is experimenting with motorized equipment for use on snow. Right, ski trooper exhibiting the clothing necessary in operations in such cold regions as Alaska and Iceland





↑ Over the snow a reconnaissance car tows an antitank gun

↓ Ski sled carries sleeping bag and one meal for platoon



Below, two views showing how the ski trooper goes into action when he encounters the enemy. At left, a soldier pulling a camouflaged sled loaded with his equipment. Right, the soldier, at the first sign of danger, quickly crawls under the camouflage sheet on the sled, thrusts his rifle through a slit and is ready to fire. His own white uniform and the camouflage sheet on the sled make the trooper virtually invisible

sleds, dog sleds, toboggans, skis fastened together and motor-driven sleds and toboggans.

One means of keeping the main body of troops, with all necessary equipment, abreast of the swift ski warrior is a toboggan and sled supply train hauled by a snow tractor that can maintain a steady pace over snow-covered country. One novel gun tractor is a sort of snow-mobile, with ski runners serving as its front wheels and with three pairs of wheels at the rear to provide traction.

First lessons with combat equipment teach the ski patrol recruit how to take various positions for maneuvers, carry packs in balance and fire rifles in kneeling and prone position. Manning the machine guns, mortars and antitank guns comes next, with the recruit learning to scoop out a "nest" in the snow for his weapons and himself, then to conceal it with white sheets. On the march, he learns to cover sleds and toboggans with white sheets. One type of hand sled is so arranged that the ski warrior may crawl under a sheet covering the sled and fire through a slit, himself and equipment perfectly camouflaged from the eyes of enemy observers.



L319

Snow tricks reminiscent of pioneer warfare are taught the ski soldier. If there is danger of being observed from an elevation, he and other members of his patrol are cautioned to move in single file, thus leaving only one track in the snow. The recruit learns to loosen his skis in order to fire in various positions, yet must keep them on to be in readiness for quick advances or shifts in position.

Most of the men in training never have worn skis before, yet their progress is far more rapid than that of the average skier. They master the principles of balance in three or four days, quickly getting the feel of the skis and then going on to the fundamentals of walking, "running," "kick-turns" and such climbing steps as the "herring-bone." Tricks of balance are acquired through use of the ski poles and in a few weeks' time, as their skill increases, the men are taught the advanced technique of controlled "stem turns" and "christies" with packs and rifles in addition to their skiing equipment. In ski patrol tactics, the rifle is hung over the back instead of being slung, thus keeping the weapon free from snow in case of spills.

Basic essentials for the ski soldier, in addition to his skis and rifle, are a pair of poles, a pair of ski boots, a pair of water-repellent ski trousers, two pairs of heavy socks, one parka, one cap, goggles, gloves and first-aid kit.

The ski patrol is far from being a "soft" part of the army, in spite of the fascination of skiing. The men must have the skill and grace of athletes, the courage of lion tamers and a generally rugged physique. Skiing is difficult and tiring enough when all you have to do is ski. Add to that the heavy equipment necessary to the ski soldier and you can understand why no electric lights are necessary in some of the training camps —the men are too tired at the end of the day to remain awake.

Sleeping in the open in sub-zero weather is serious business, too. To prevent the men from freezing to death, guards are assigned to make frequent rounds among their sleeping fellows, a precaution common in the Finnish army.

Large scale training got under way last winter for the first time in this country with picked units of the First, Third, Fifth and Sixth Divisions of the regular army and the Forty-first and Forty-fourth di-

(Continued to page 178)

JANUARY, 1942

L319

5156

Power-Drill Extension Arm ✓ Works at Any Angle



Extension drills at angle in places hard to reach

Drilling in high, hard-to-reach places and at odd angles can be simplified by fitting a lightweight extension arm to the electric drill. The telescoping tool, attached to a drill in three minutes, permits adjustment to any angle through 360 degrees. It is carefully balanced for precision work.

L1123

Mixer Shaped Like a Dumbbell ✓ Is Shaken With One Hand



There is a good swirling space in each end of a dumbbell-shaped shaker which assures thorough mixing of the beverage, fruit juice or salad dressing. The mixer is of glass, reinforced with metal parts.

*National Silver Co. Inc.
Merchandise Mart
Chicago 3, Ill.*

✓ Trouser Legs Tied at Cuff
Are Handy Water Wings

Bob Petersen

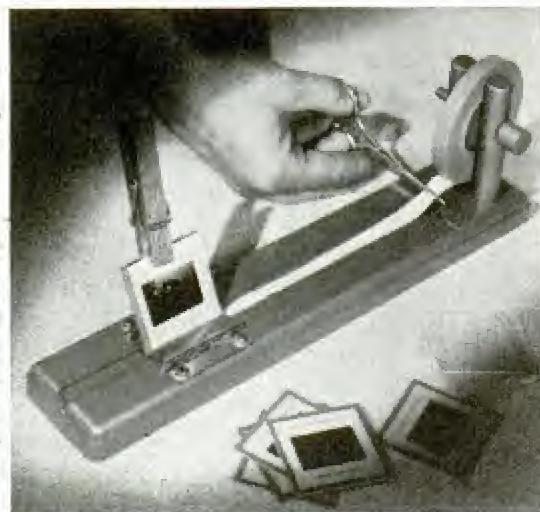


Acme.
Knotted trouser legs are blown up for water wings

Water hazards during army maneuvers are no obstacle to the soldiers at Fort Rosecrans, Calif., since Homer Groening conducted the Red Cross lifesaving course there. He taught them how to make water wings of their trousers. With a few twists of the wrist, a tight knot is tied in the end of each trouser leg, and with air inside the trousers balloon up into buoyant wings.

✓ Binder for Color Transparencies
Centers Tape Automatically

Binding color transparencies or black and white slides in glass is an inexpensive operation with a new low-cost home binder



Acme.
Binder centers glass slide while the tape is applied

that any camera fan can use. A specially designed guide automatically centers the edge of the slide on the tape, and just enough binder tape for one slide is easily measured and cut from the reel. Then it is necessary only to revolve the slide until all four edges are covered and the tape pressed firmly against the glass. Trimming the tape at the corners completes a neat job.

✓ 2944

Electric Gauge Shows Thickness
✓ Of Engine Cylinder Walls

Inspection of every engine produced for Pontiac automobiles includes measurement of the thickness of the cylinder walls, which is performed with an electrical gauge. Special coils in the instrument, which is inserted into each cylinder, create



Gauge measures auto cylinder wall in inch fractions

a magnetic field in the metal walls, and the gauge above them measures the intensity or volume of the magnetic field thus created, translating the measurement to a scale graduated in fractions of an inch.

✓ 2944

Weather Maps Made Easy to Read
✓ By New Set of Symbols

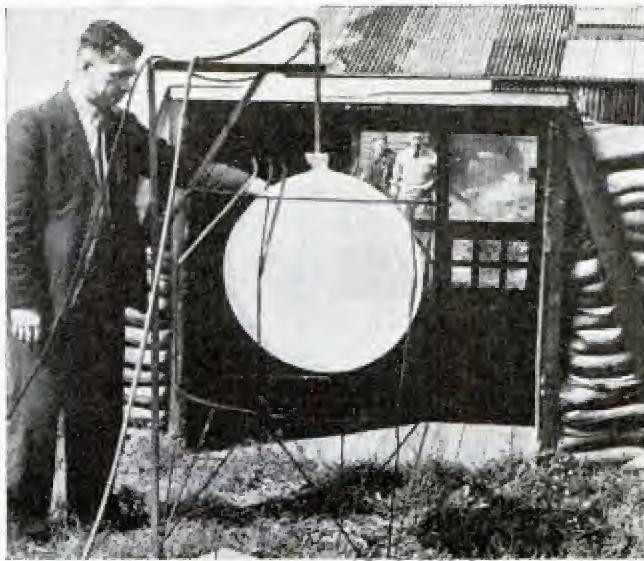
Weather maps soon will have a new set of symbols to indicate weather conditions throughout the United States. The symbols look like Indian picture-writing, with a suggestion of shorthand thrown in, but their meanings will be easy to read, as most

of them have a graphic resemblance to the things they represent. For instance a round dot means rain, a six-pointed star means snow, a white circle means a clear sky, and so on through a gamut of symbols that will show the degree of cloudiness, barometer state, direction and force of wind, kind of precipitation, and other weather facts. These marks will be grouped around every city where there is a weather bureau observatory. Air masses also will be indicated, with letters showing polar or tropical origin, and whether they are warm or cold. The fronts where they come in contact will be shown, since it is at these fronts that liveliest weather changes often take place.

21050

Bomb's Effect on Taped Window Tested by Explosive Balloon

Adhesive tape applied in strips to windows in localities subjected to aerial bombing is helpful in protecting the glass against shattering. Experiments made at the British Ministry of Home Security Research Laboratories, to determine in which designs the tape is most effective, required the building of a tunnel-like structure in which four specimen windows are installed. These are treated in various forms with adhesive, and then a large balloon charged with explosive gases is fired electrically, throwing a blast wave into the tunnel. The effect of the blast approximates that of a 500-pound bomb striking about 80 feet from the window.



Bursting balloon tests strength of adhesive-treated window

JANUARY, 1942

Foot-Power Hydraulic Vise Speeds Shop Production



Pedals control movement of vise by hydraulic power

Saving time for the workman, a hydraulic vise operated by pedals leaves both hands free, thus also permitting greater accuracy in handling the work. Three pedals, all contained in a compact control unit resting on the floor, move the rear vise jaw forward and backward, the front jaw being stationary. One pedal eases the jaw against the work, and then pressures up to five tons at the jaws may be applied by operating a second pedal. The third pedal releases the jaw. Adaptable for many tasks in the home or shop, the vise can be mounted horizontally on a bench or vertically on a wall or post. It is said to be especially suited for press work, punching, bending, cutting, testing and stamping.

Express shipments of live bees during last spring's shipping season totaled 310 tons, the bees averaging 4,500 to 5,550 to the pound.

Railroad tags
Oct. 4, 1941, No. 547

290 E. Eastman Kodak Co., Rochester, N.Y.

✓ TRICKS with Your CAMERA



Trick picture, left, is made by superimposing photo of boy with hands around knees on photo of jar with boy pointing to it. Ghost photo, right, is made by shooting the door, then, without moving camera or winding film, snap someone dressed in sheet at door, using half the exposure time of the first shot.



TRICK pictures can be taken with any camera—whether it's an inexpensive box camera or one of the finest cameras made. The key to trick pictures is to show something that seems impossible to accomplish—and as soon as someone sees such shots he knows that trickery is involved. The actual means, of course, should be concealed, so that people don't "catch on" at the first glance. For example, did you ever see the picture of a boy, his eyes crossed, balancing a half-dozen eggs on his nose? Here is how you can make such a picture. Take six eggs (well drained of whites and yolks), string them on a dark thread, and suspend them from the ceiling in front of a dark background. The subject stands under the eggs, tilts his head until his nose just touches the bottom of the lowest one, looks cross-eyed, (if he wants to add a little comedy)—and you snap the picture.

← Turn this picture upside down and see how it was snapped; trousers were pinned up, necktie held up with wire, camera was pointed down

21109

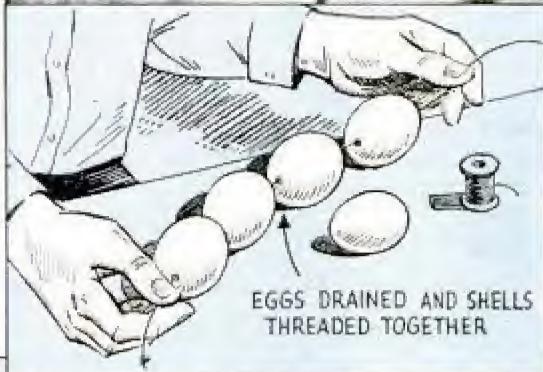


Cut out pictures of Indians and paste on stiff paper with pin at foot to hold erect on pillow; arrange figures and child, then shoot with camera on firm support. Now take away figures and tent and shoot again on same film. During this exposure details blocked out behind figures record, making figures appear translucent, as in a dream.

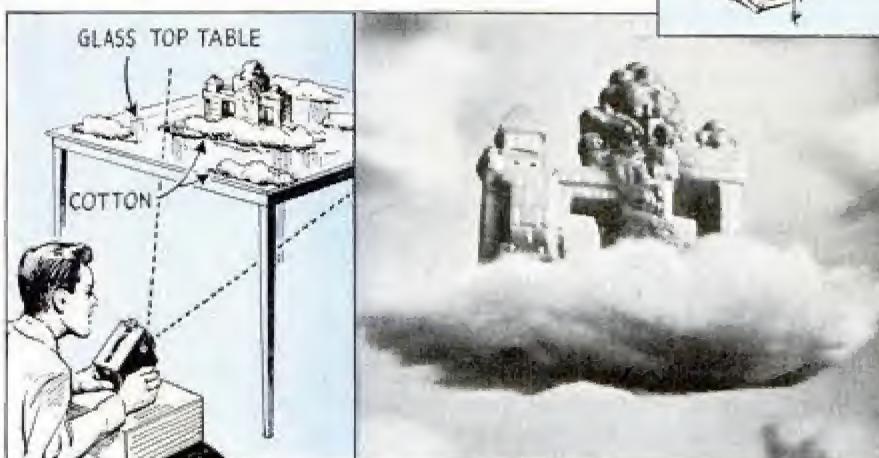
You can suspend other objects in the same manner, for a variety of photographic tricks. For instance, you might show a person enchanting a small book by having it appear to be floating in mid-air.

There is one point to remember here—even a black thread will show if you have too much light on it, so it must be shaded in some manner. The simplest method is to have someone hold a piece of cardboard just outside the picture—adjusting it to cast a shadow on the thread. Outdoors, when you use the sky as a background, have the color of the thread match the sky.

(Continued to page 169)



EGGS DRAINED AND SHELLS
THREADED TOGETHER



↑
Startling photo—anyone can see it's a trick—is made by draining eggs, threading them together and suspending so subject's nose may touch them. Camera does the rest

← Diagram shows how toy castle may be made to appear floating on cloud by using cotton and glass top table, shooting in camera position shown. Portrait attachment permits shooting closeup

Steel Frame Puts a Crease In Washable Trousers



Adjustable frame helps crease trousers after washing

Much of the work of pressing trousers is eliminated by the use of adjustable frames of flat steel which put back the crease while the trousers are hanging up to dry. They are adapted to anything from light wash trousers to heavy corduroy. After washing and wringing, a frame is slipped into each trouser leg, wrinkles are smoothed out and the trousers are hung up to dry and crease themselves.

Hourglass Timer Rings a Bell When Set Time Elapses



80 Similar device
is made
below Louisville

three, four or five minutes. The unit, which may be fastened on the wall, is handy for timing eggs, long distance telephone conversations, or photographic work.

L 652.

Scale Locates Center of Gravity Of Heavy Objects

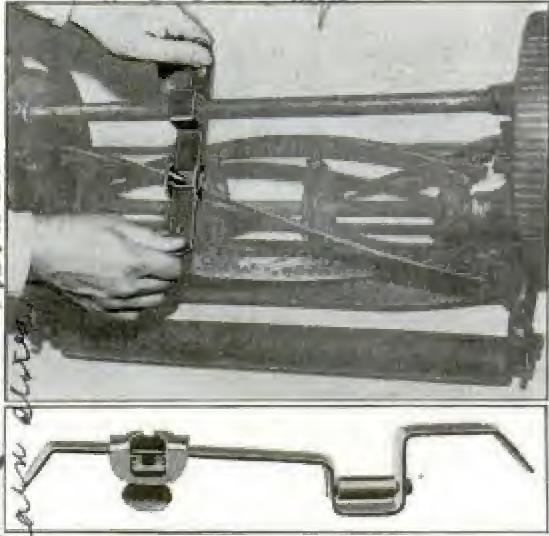
Products with better balance may be designed in the future with the aid of a platform scale, recently announced, that finds the center of gravity as well as giving the weight of anything from a casting weighing 500 pounds to a long-range bomber weighing 100 tons. The scale has two levers, each equipped with two fulcrums. One fulcrum point on each lever is used to indicate the weight of the object, and the other set of fulcrums is operated when the center of gravity is to be determined. According to the manufacturer, the center of gravity is located easily and quickly when the inch-pounds determined by one set of fulcrums is divided by the true weight found by the other set. Three gravity readings are required in computing the center of gravity.

L 955

Simple Lawnmower Sharpener

Adjustable for All Sizes

175 cents ap



Top, operating sharpener; bottom, it has few parts

So simple in design that the most inexperienced person, even a child, can operate it, an inexpensive lawnmower sharpener now on the market will complete the job in a few minutes. Small enough to fit the tool kit, the sharpener is readily adjustable to standard lawnmowers of any size.

POPULAR MECHANICS

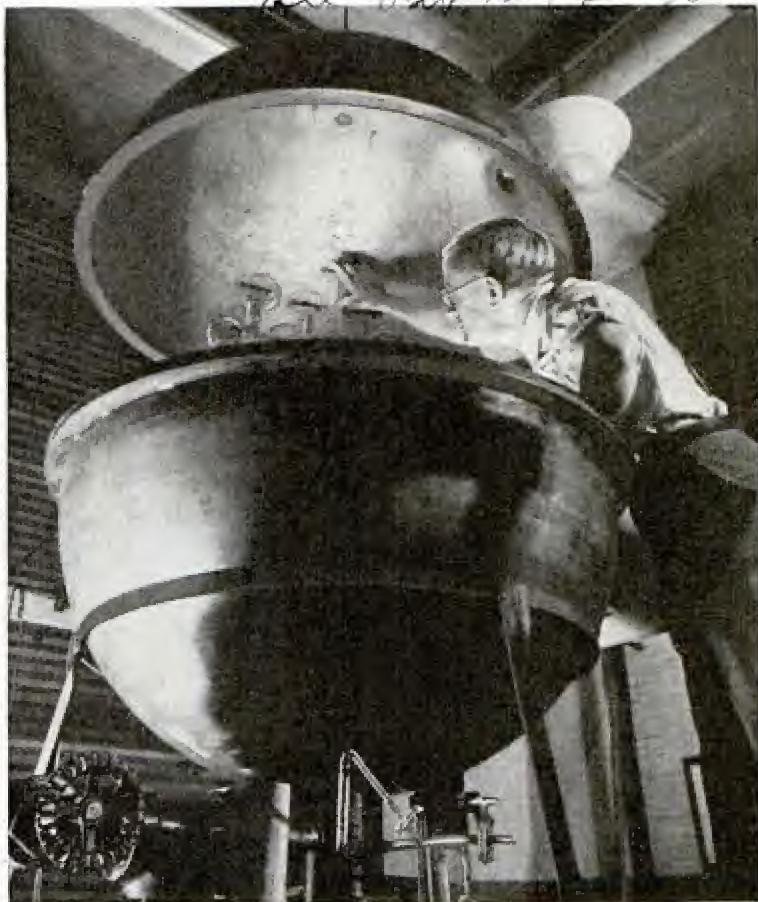
Box 129 May 1934

2/10/59 Under direction of Mr. C. W. Jewell
Glass Made Glareless by Thin Film Coating

see Feb 1942 - 28

Annoying glare from glass can be removed by coating the surfaces with a film 1/300,000 inch thick. The advantage of the new over earlier processes is that the glass may be handled without damaging the nonglare surfaces. Glass to be treated is placed in a large metal globe developed at General Electric's research laboratory in Schenectady, N. Y. After as much air as possible has been removed from the globe, a tiny quantity of magnesium fluoride is evaporated electrically, coating each surface with the superthin film. To hold the glass in the globe it is mounted in a metallic frame so it will stick to alnico magnets.

Glass to be given nonglare treatment is stuck inside sphere by alnico magnets, and coated with film of magnesium fluoride



2/10 April 1942

2/10/59 Homemade Car and Trailer Include Parts From 16 Autos

Touring the highways in the northwest section of the country are an odd automobile and a trailer built by D. W. Tiffany of Helena, Mont., for calling on merchants spread over a wide territory. The body of the car, fashioned by hand, has a wood framework covered with 20-gauge sheet iron. Into the rest of its construction went parts from 16 different makes of cars.



Note exhaust mounted at side of car and powerful light on top

Frames from two were joined to give the car a 140-inch wheelbase. The braking system is mechanical with a booster made from a vacuum cylinder and operated from the intake manifold. Two vacuum cylinders that set the trailer brakes before the car's brakes take hold, prevent bunting of the trailer. The car is elaborately lighted, permitting use either of two driving lights

or four powerful beams for the open country. An overhead light with sharp focus may be tilted or turned, using power from one horn motor and one windshield motor. Signal lights at the front of the cab and on the rear door indicate the intention of the driver to turn. The exhaust system is mounted on the left side of the car to save the muffler and exhaust pipe from damage on rough roads. The trailer houses a refrigerator and a pantry.

TAMING the THUNDERBOLT



Preparing 12-lens high-speed lightning camera for action in laboratory at Pittsfield works of the General Electric Company



Spectacular photo of continuing flash of lightning in Switzerland

ONE stormy day, not long ago, lightning struck an electric transformer in Grand Rapids, Mich., starting a fire, but a second bolt immediately hit a fire alarm box nearby summoning firemen who put out the blaze. Another discharge the same day killed a man atop a mountain near Wilton, N. H., but did not touch his bride standing at his side.

History and folklore are packed with pranks—often grim ones—played by shafts of electricity flashing between sky and earth. Like the incident of the farmer who piled kindling in his stove for morning and was awakened on time by an ear-splitting crash, but found everything unchanged except that the wood was burning merrily and the stove was ready to cook breakfast.

So puzzling and propitiously timed are these tricks wild electricity has played on mankind that for centuries they were classed as religious manifestations, angry voices of the gods, and so on.

But modern science is not so easily satisfied. Beginning with Franklin's experiment with a kite nearly 200 years ago, sporadic research revealed much about lightning's na-



Bottom, left, vaporization of resistance wire with impulse current in high-voltage engineering laboratories; right, effect of high magnetic forces on thin copper strap after discharge from 265,000-ampere lightning generator

1942

L.B. Johnson

This lightning camera has two lenses and its film turns at a rate of 3,600 revolutions per minute, enabling operator to photograph multiple strokes of lightning bolt

ture. More lately, the stringing of millions of miles of power lines and radio antennas and the construction of thousands of transformers, generating stations and other electrical equipment which seemed to be the special target of ravaging flashes, made the problem of their protection a practical and pressing one.

Twenty years ago the great scientist and mathematician, Steinmetz, disturbed because lightning crashed into his summer camp near the

Distribution transformer carrying current into miniature house resists 3,000,000-volt lightning bolt, thus keeping lights on in the house

Westinghouse photo



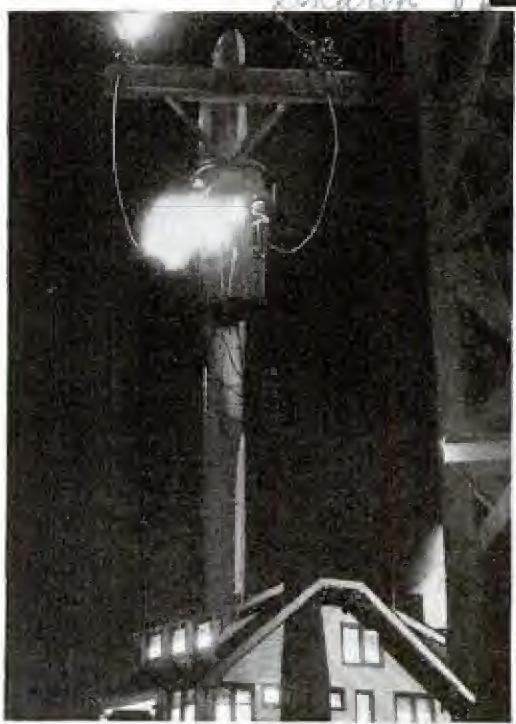
Shared by



Fixed lens catches lightning stroke as eye sees (center) while rotating film records it as one consisting of one long-continuing low-current discharge and six non-continuing discharges

General Electric plant at Schenectady, N. Y., and shattered objects on his workbench, settled down to solve the mystery of lightning, especially as it affected the electrical industry.

Today, as the result of the labor of men who have followed him in these same General Electric laboratories, and the research of engineers for such corporations as Westinghouse and the Bell Telephone System, it is safe to say for the first time that science



has actually started taming the thunderbolt.

The Pennsylvania Water and Power Company, which operates through storm-ridden territory, recently reported that magnetic recorders installed on transmission towers revealed that two highly insulated 200,000-volt transmission lines were struck 573 times without damage affecting service. A few years ago any one of these lightning flashes might have blacked out wide areas.

Several different kinds of efficient electrical traffic cops are used to chase hit-and-run lightning bolts off the regulated traffic lanes provided by power equipment and the scientists are now engaged principally in cutting costs so that domesticated electricity may be protected in its useful tasks at least expense.

The hope now is that this continuing line of research will eventually

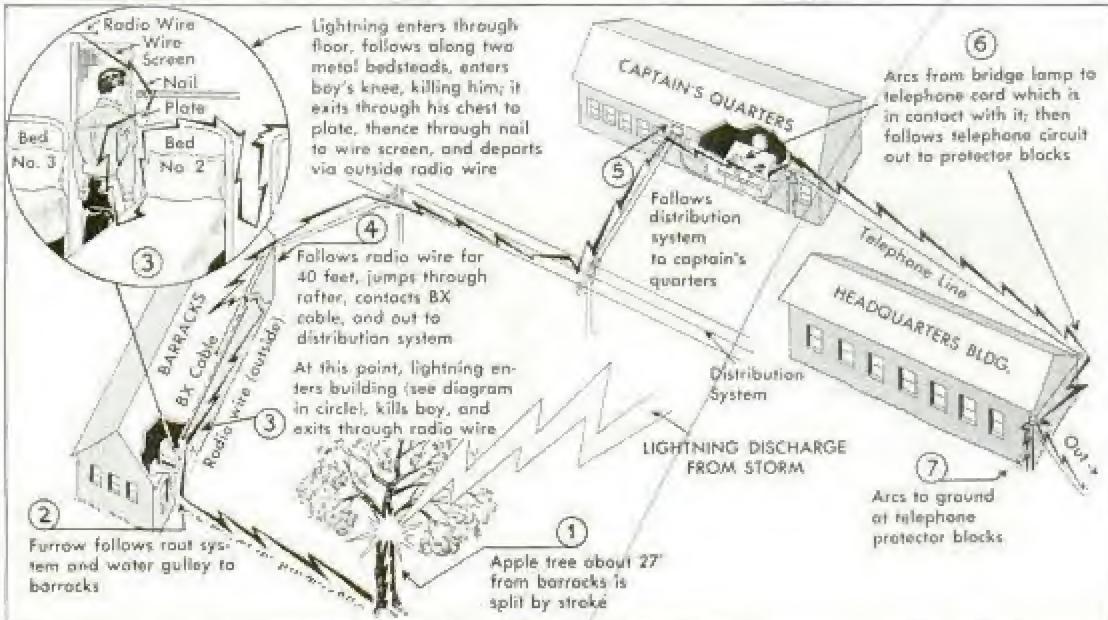


↑
Dr. McEachron (right) pointing out factors in modern metallic plane which affect its safety with regard to lightning



← View finder on giant camera pointed at Empire State Building lightning rod is a rectangle cut in wooden mask which replaces top panel of office building window

Diagram showing Dr. McEachron's reconstruction of course of lightning which killed member of Civilian Conservation Corps



2892

extend some such thunderbolt protection to man himself and his other accessories of civilized life.

Scientists say that one of their number, Dr. Karl B. McEachron of General Electric, can do anything but grab a lightning bolt by the tail in the strangest of laboratories which are centered about the Empire State Building in New York. McEachron, realizing the inadequacy of the human eye to stop a current timed in millionths of a second, freezes the flashes with cameras and measures their power with oscillographs.

One camera, which resembles a bizarre Martian gun, contains film revolving on a drum which turns at a rate of 3,600 revolutions a minute splitting a lightning flash into its component parts. This camera proved that many bolts to the Empire State building begin at the building and extend themselves to the cloud. Another camera holds film which revolves only 120 times a minute. A third has four lenses with shutters set at different apertures.

Minute examination of these films, modified by the readings from a photometer of barrel-like width to measure the visibility between the skyscraper at Fifth Avenue and 42nd Street, where the cameras are located, and the Empire State building 2,550 feet away, provide accurate facts about lightning strokes. Too, with the aid of oscillograph records made atop the Empire State building, it gives the duration, speed, intensity and power in a bolt. Sixty-four strokes have been photographed. A moving picture camera, located in another building and operated by the lifting of a telephone receiver in the 42nd Street structure, takes pictures of the stroke from right angles, to establish its shape.

Another setup just as ingenious in Pittsfield, Mass., records lightning strokes on the surrounding countryside.

And, as might be expected, Dr. McEachron and his skilled aids have discovered many things that our eyes would never have told us. For one thing, most of the strokes dart upward from the Empire State building and not down from the clouds. The upward flash paves the way for the downward stroke. This is because the 27-foot lightning rod above the 1,265-foot edifice acts like a needlepoint to draw electricity from the metal conductors and pipes below the city's streets and sends it winging into the air toward a cloud-borne gath-

(Continued to page 162)

✓ Bureau Mounted on Door Saves Space in Room



Bureau disappears into closet when door is closed

For convenience in cramped living quarters, a compact bureau containing drawers, shelves and a mirror may be fastened to the inside surface of any ordinary closet door. It occupies only two and one-half square feet of floor space and converts even a skimpy closet into a private dressing room. Other units available which are also easily attached to doors are a kitchen cabinet, linen closet and wardrobe cabinet.

21122

✓ Jig-Saw Cutter for Grapefruit



Grapefruit sections can be cut quickly and neatly with a "jig-saw" cutter whose looped blade is worked up and down around the pulp, then under it. This frees the pulp section for serving.

6-Piece 'Knock-Down' Stool Is Set Up Quickly



The six parts in inset make up this three-leg stool

Held together without nails, three wooden poles and three disks fit together to make a strong three-legged stool that is handy for campers, autoists, milk maids or shop workers. One large disk forms the seat and the other two act as supports to bind the pieces firmly. A small spring between the two smaller disks is the only metal used. The stool can be taken apart easily and takes up little room in the luggage compartment of a car.

1952 Nonslip Pressure-Grip Wrench Holds With Three-Face Jaws

Accidental injury to the hands and damage to the work caused by wrenches slipping off the nut may be eliminated with an adjustable wrench that makes a three-face contact on hexagon nuts, and locks in a firm pressure grip in contrast to the usual



Lower jaw presses two faces against hexagon nut

sliding grip. The pressure grip, however, is used only in tightening and loosening a nut, the tool being adjusted to an ordinary sliding fit for turning loose nuts. The wrench holds hex, square or round nuts.

1946 Copper-Cement Flooring at Pool Kills Athlete's-Foot Germs

Danger of getting athlete's foot from floors of swimming pool runways and locker and shower rooms may be reduced by surfacing the floors with a copper-cement material called Hubbellite. Developed by D. S. Hubbell at the Mellon Institute for Industrial Research in Pittsburgh, Pa., Hubbellite kills germs by releasing minute amounts of a copper compound from the flooring when it is wet. In tests made recently, fungi on Hubbellite were reduced from 72,000 to 74 after eight hours.

1948 Prefabricated Calking Cord Seals Window Cracks



The calking cord is pressed in place with a finger

Cracks around windows and doors can be sealed quickly and easily with a prefabricated calking cord just brought out. No tools are needed. The puttylike cord is simply applied to the space to be caulked and strung along the crack, then pressed in with a thumb. It can be painted at once.

L988

esraul

Man's Mechanical Arms Load Defense Cargo



† Huge pipes carry a stream of oil, lifeblood of engines in war and peace, into a Socony-Vacuum tanker, later unload it from ship's hold to storage tanks



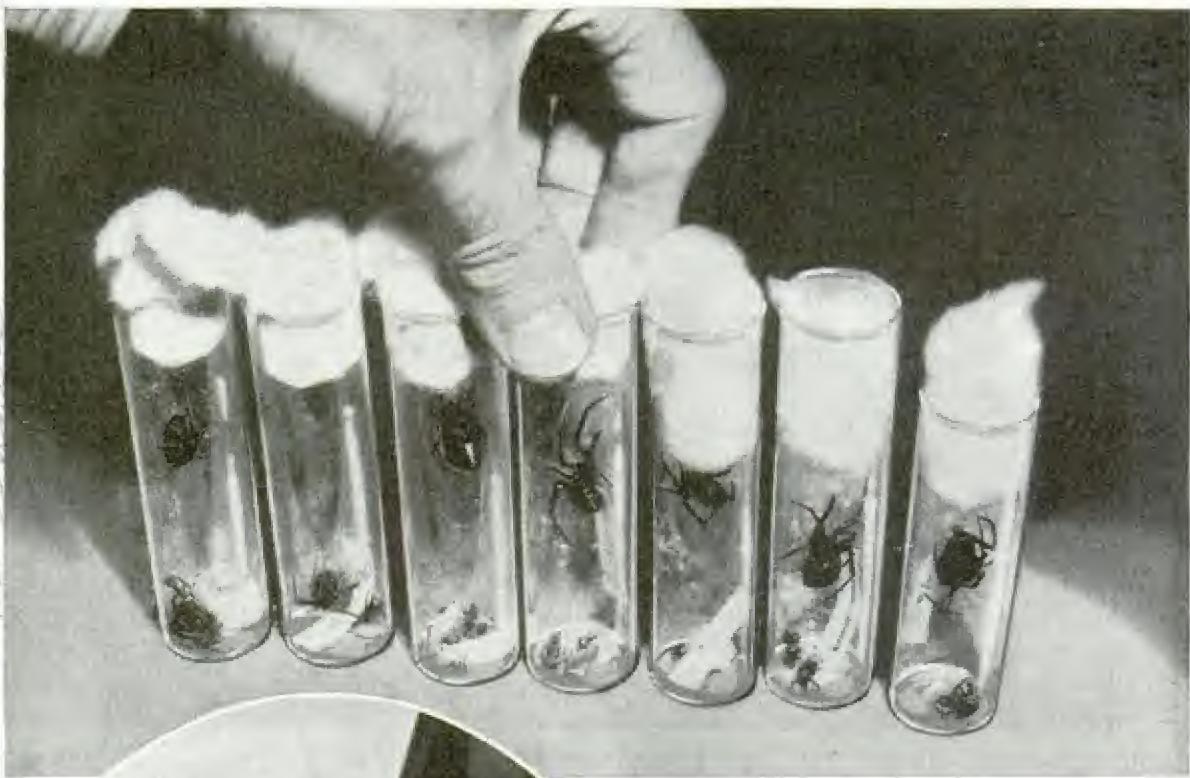
Docks and freight yards are busy as never before, loading and unloading the cargoes that keep America's defense industries throbbing at high pitch and help provision her friends abroad. Oil tankers swiftly pour their loads of fuel from Gulf fields into storage tanks on the eastern seaboard or ply across to Britain. Mechanical loaders like the truck above pick up freight and trundle it aboard box cars.



Photo from Electric Controller & Mfg. Co.

The huge shovel above, its operator riding inside the giant arm, at one scoop lifts 15 tons of iron ore from the hold of a freighter at the Carnegie-Illinois Steel Corporation dock at Gary, Ind. With a battery of these unloaders, a 13,000-ton ore cargo is put ashore in four hours. Electric "stevedore," left, a 65-inch magnet, speeds loading of scrap iron and similar cargoes, handling up to 100 tons an hour.

NEMESIS of the BLACK WIDOW



There is enough poison in these seven Black Widow spiders to kill several men

→ Spiders are fed flies which are trapped in a box and then attracted into tubes

Weight for weight, its poison is 16 times more deadly than that of a rattlesnake. However, due to the tiny amount of poison carried by the Black Widow, its bite is less serious than that of a rattler.

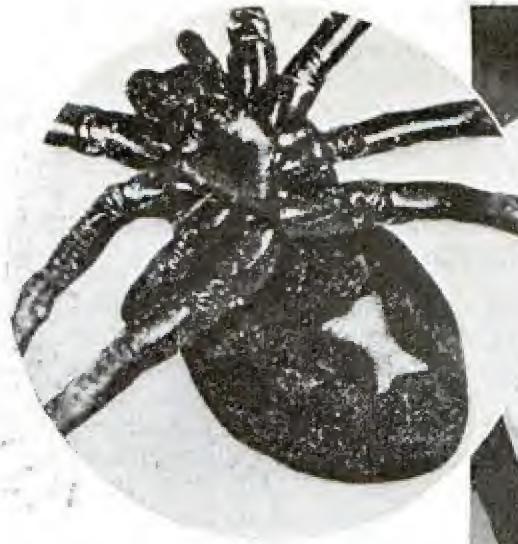
Readily recognizable because of the brilliant red hourglass marking almost always present on the underside of its jet black abdomen, the Black Widow spins its webs and lays its eggs in wood-piles, dark corners of attics, rubbish piles, even in seldom-dusted corners of rooms which are in daily use.

The Black Widow is a serious problem both in the United States and the Hawaiian Islands. For years it has been a menace in the sugar plantations, and many efforts have been made to destroy it. But now it seems likely that a chance discovery will beat the Black Widow. Not entirely chance, perhaps, for if certain scientists, and one in particular, hadn't seen the sig-

THIS is a strange story. It began on the "Grand Sand Dune" near Los Angeles, where science by chance has found a weapon against a killer that may lurk in your home.

That killer is the Black Widow spider. Existing in practically every part of the United States, equally potent in winter and summer, the Black Widow has caused numerous deaths, untold pain and injury.

2936 Oct 123 W. George Pierce
of the American Museum



Enlarged picture of underside of Black Widow shows the red hour-glass mark typical of the species

nificance of a lucky discovery, the answer to the Black Widow menace might be as far off as ever.

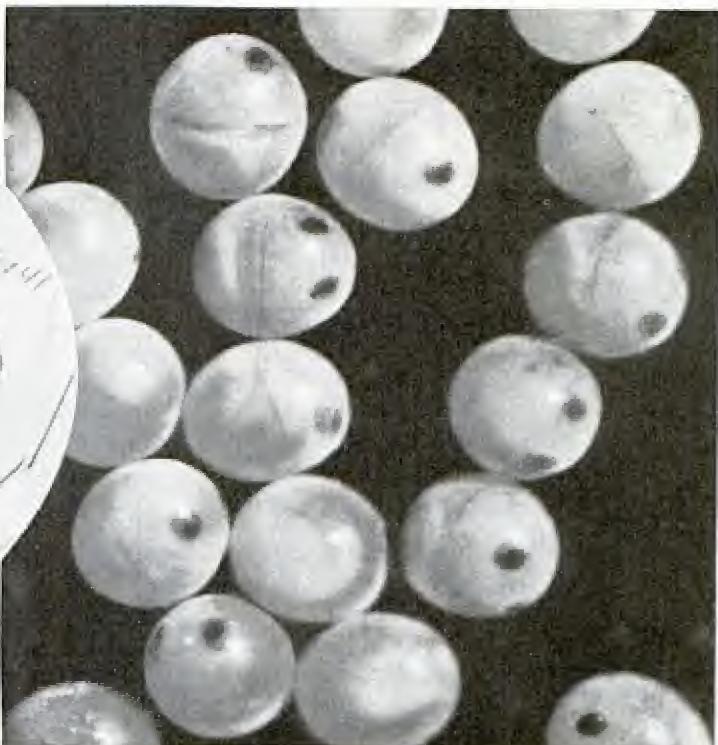
Near Playa Del Rey, Calif., is a desolate windswept stretch of sand known as the "Great Dune." It is one of the few areas along the Southern California coast which has been unchanged by civilization. It is exactly as it was when the first Spaniard splashed ashore.

(Continued to page 173)



Collecting Black Widow eggs infected with wasps in California

Photomicrograph of spider eggs, each dot representing a wasp



Mounting a specimen of the deadly Black Widow. Weight for weight, its poison is 16 times more potent than the venom of the rattlesnake

✓ 993

Children Ride Rumble Seats Mounted on Family Bike



Pair of rumble seats on bicycle carry two children

With their auto rendered immobile by gasoline scarcity, one family in Sweden now takes Sunday jaunts on a bicycle built to carry mother, father and their two children. To a two-seat tandem have been added a couple of baby-size sidecars attached at the rear wheel.

✓ 994 Mankato, Minn.
workman turns the knurled top to the drill number and it is made available immediately. The cylindrical case is five inches high and a little more than two inches in diameter, fitting any tool box.

✓ 996
Grain Made to Smell Like Skunk
To Guard It From Rats

Casting about for some method of keeping rats out of grain stored in sacks, two Minnesota chemists thought of the rat's natural enemies—skunks and ferrets. They knew the chemical basis of the strong, musky odor of these two animals is a chemical compound called n-butyl mercaptan. They tried flavoring the food of captive white rats with this "skunky" odor; the rats refused it, became restless and even fought each other. Further experiments developed that honey would hold the chemical odor most satisfactorily—as long as six months, well in excess of the time normally spent in storage by grain and commercial foodstuffs. So artificial skunk odor now protects grain from rats.

✓ 997 Pencil 1851
Pencil Lights Its Way in the Dark
With Flashlight at Point

Light for visibility in writing in the dark is supplied by an illuminated pencil now on the market. An electric bulb mounted above the lead shines through the transparent housing at the tapered end. The body of the pencil holds a battery and a cap at the top controls the switch. The pencil is handy as an emergency flashlight.



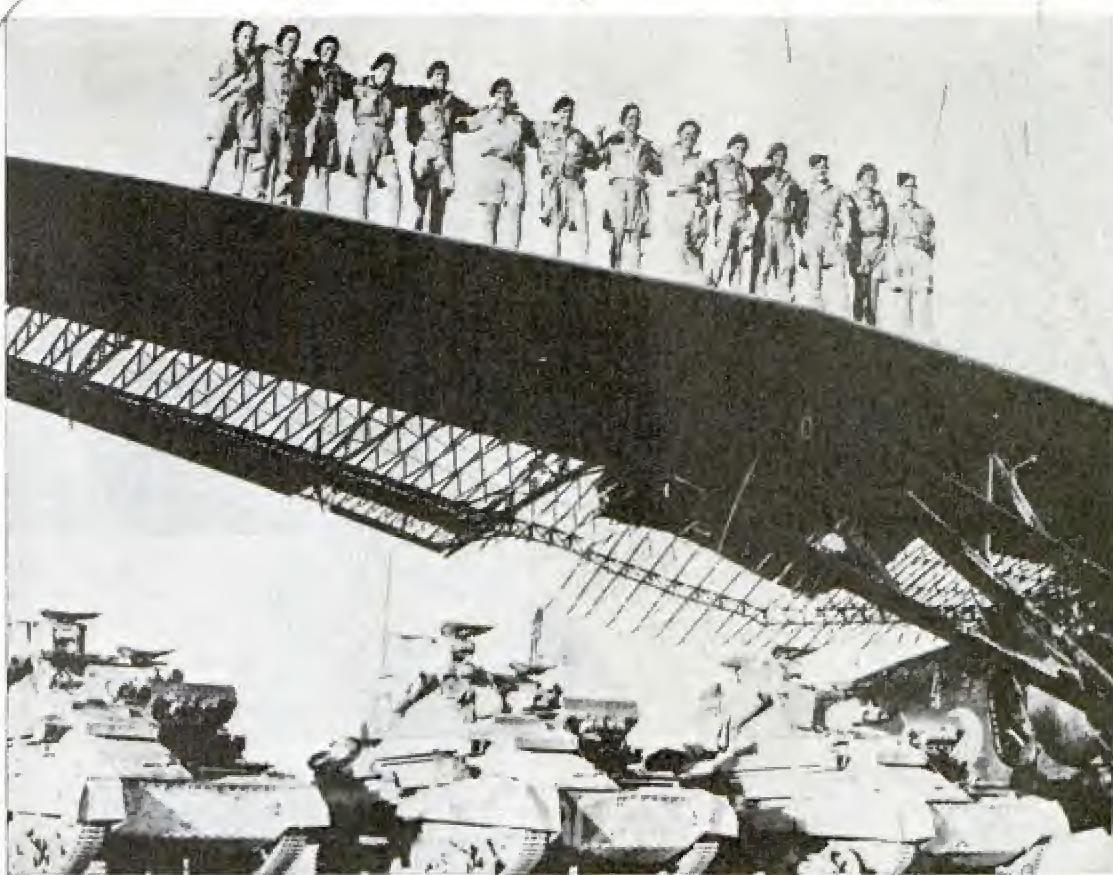
Transparent housing lets light shine on writing

✓ 998 Overbridge & Jones
6125-26th Ave - Wis
Kenosha, Wis

POPULAR MECHANICS

L105/

Men on Wing Show Huge Size of Troop Plane



Men on wing and tanks assembled beneath give a good idea of the size of this troop-carrying plane

Three tanks parked beneath a large wing, with room to spare, and fourteen men standing on its top surface, indicate the massive size of a German troop-carry-

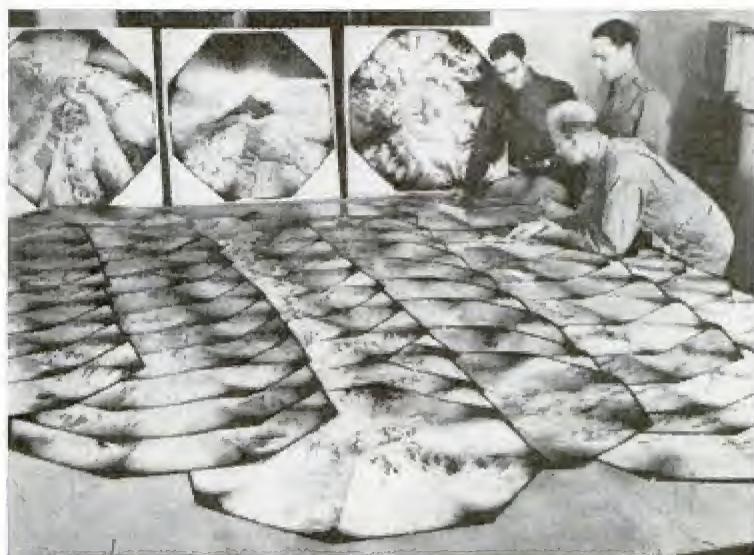
ing plane being used in the European war. This ship was forced down by units of the Royal Australian Air Force as it was attempting to leave Syria.

L975

Aerial Mosaic Map of Vast Area Made With 9-in-1 Shots

Using a series of aerial photographs, the Fourth Photograph Squadron has completed a mosaic map outlining a practice range for the new gunnery school of the U. S. Army Air Forces in Nevada. Each photograph is an octagonal print consisting of nine aerial shots taken simultaneously. The prints are matched and fitted together.

Each aerial print consists of eight wedge-shaped sections converging toward an octagonal section, the ninth one, in center

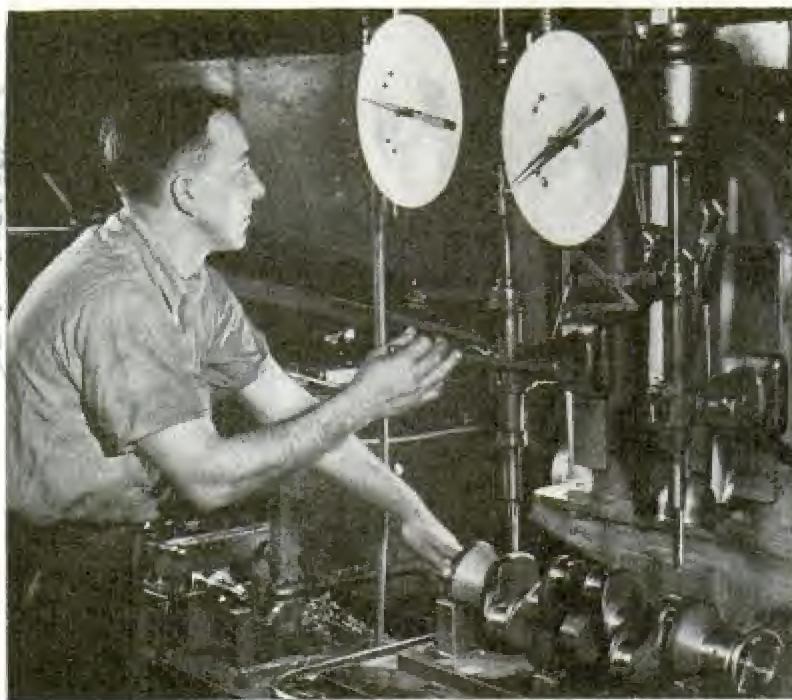


JANUARY, 1942

Las Vegas

Wade Wall 91

BALANCE—THAT'S *the* SECRET



↑ Balancing a brake drum. This helps to eliminate vibration in your automobile

← Operator watches dial to determine amount of excess material to be removed from crankshaft

SO ACCURATELY designed and built that its smooth operation can be upset by the weight of a thin dime, today's automobile engine is far better than those of a few years ago because the vibration fighter has joined hands with industry.

And for the same reason your vacuum sweeper, your electric razor, your oil burner or stoker and other home devices give years of trouble-free service and the air-

plane engine and propeller run for scores of hours without a major overhaul.

Vibration always has been the enemy of machines, particularly those containing rotating parts, because it literally shook them to pieces. Early engines could operate at only slow speeds without causing objectionable and destructive vibration. The demand for more speed brought with it the necessity for doing something about keeping vibration at a minimum. Men who worked with engines and other mechanisms containing rotating elements discovered that balancing the rotating parts was the only way to combat vibration and noise. And thus began an all-out war on vibration.

Centrifugal force—the invisible but very real pull into space exerted on any object rotating about an axis—is the crux of the problem. If one side of the object is

Bulges in line on indicator of static balancer show where flywheel being tested is heavy



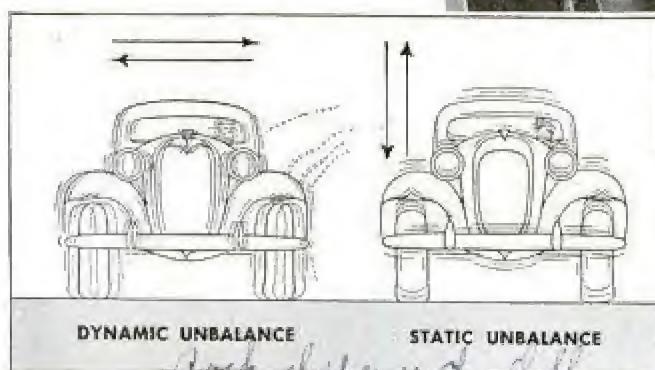
heavier than the other, then the centrifugal force due to that unbalance increases as the square of the speed of the moving part. This means that doubling the speed increases the force four times; tripling the speed increases the force nine times. The vibration fighters, those engineers seeking to solve the problem, soon began using a unit for measuring unbalance in connection with centrifugal force. It is the ounce-inch—the weight of one ounce at a distance of one inch from the center of rotation.

Thus we find that an unbalance of an ounce-inch creates a force of 1.5 ounces at 200 revolutions



↑ Marking light point on tire casing on balancing machine in Firestone factory inspection

↓ Balancing "squirrel cage" fan for home ventilation on a Gisholt dynetric machine

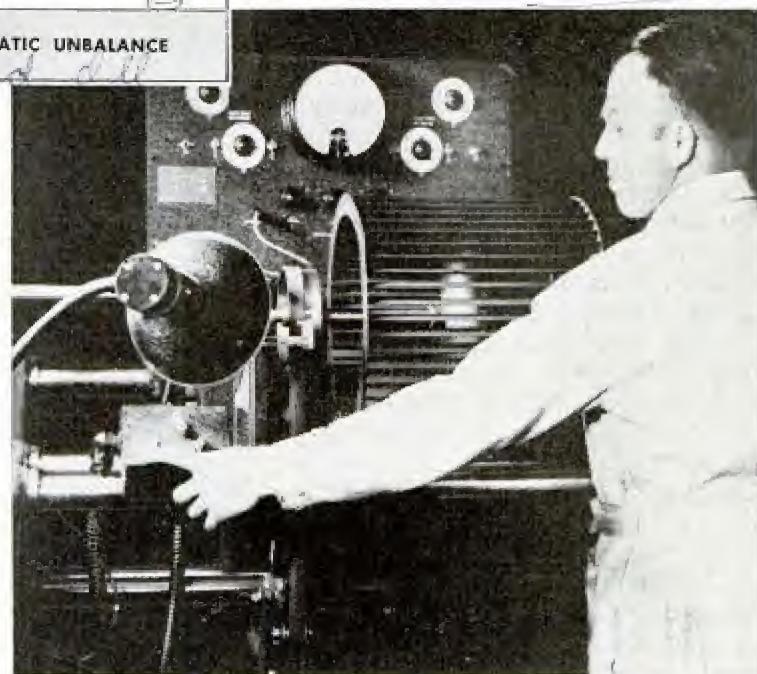


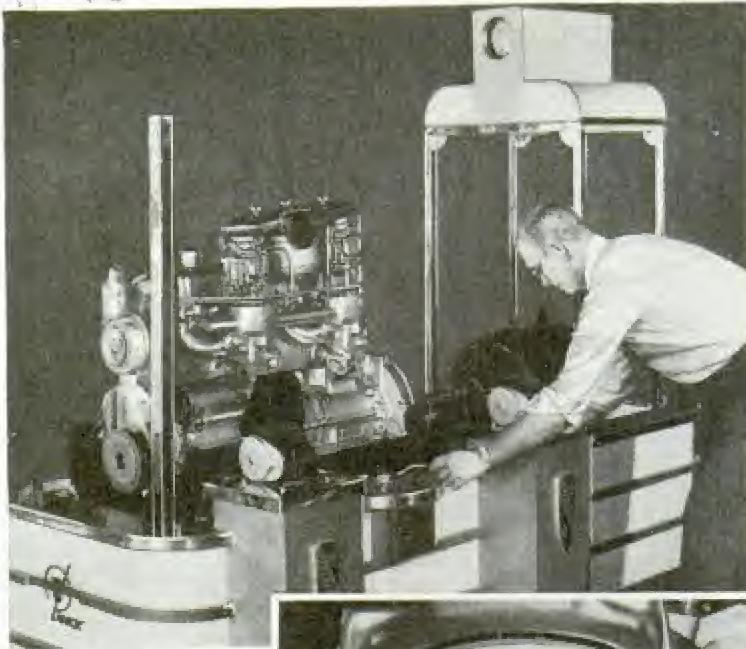
Courtesy Bear Mfg. Co.

Showing result of car running with wheels dynamically unbalanced and another with wheels statically unbalanced

per minute, but when the speed is increased to 5,000 revolutions per minute, the force jumps to 41.3 pounds, sufficient to cause injurious wear on every rotating part.

The internal combustion engine in the modern car turns over at speeds running into thousands of revolutions per minute, and even a small amount of unbalance at these speeds can cause a high

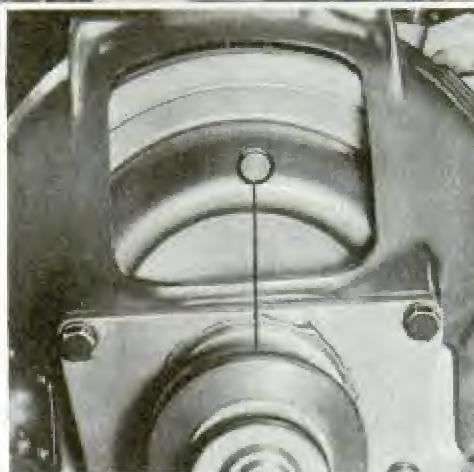




Apparatus demonstrating delicate balance of Buick engine. Pushing lever throws weight of a dime (see photo at right) to one side or other, upsetting smooth operation of engine

degree of vibration, resulting in mechanical failure. The same holds true for a vast majority of the engines and electric motors in use today. As the speed and power of the automobile engine were increased it became imperative for engineers to develop balancing machines that would indicate a state of unbalance and provide for its correction in moving parts such as flywheels, crankshafts, wheels, tires, clutch disks, cooling fans and many others.

Early machines for determining unbalance were simply glorified "guessing" machines, according to Werner I. Senger, chief development engineer of the Gisholt Machine Company. The result produced by the combination of machine and operator was largely dependent on the skill of the operator. These machines required that by a trial and error process, the operator add or remove unbalance as by shaving off a bit of



metal or drilling a hole in a flywheel to reduce weight at the point of unbalance. If the operator had sufficient patience and skill, it was possible frequently to obtain good results. But too few men possessed the ability to become such skilled operators, so the vibration fighters developed better balancing machines, year by year, until today these machines require little skill in operation. The operator of the newer type of balancing machine reads exactly the depth to drill a given size of hole at a given point or points to produce a condition of balance; or he may read directly the number of 64ths of an inch of length of strip steel which must be add-

Weighing pistons in Chevrolet factory to obtain matched sets according to weight within very close limits



K 1173

ed to a part at a definitely indicated position in order to produce perfect balance in the part.

Naturally a high degree of accuracy is necessary in this work. Engineer Senger tells of one job in which the requirements are that the center of gravity of a body weighing 11 ounces be balanced to such a point as to reduce the displacement of the center of gravity from the rotational axis to .000001 inch, which represents an unbalance of 11 millions of an ounce inch.

A small unbalance in a vacuum sweeper running at 12,000 to 20,000 revolutions per minute will produce unbalance forces of a high order, due to the presence of the large centrifugal force developed at these high speeds; and this large force, in addition to producing noise and vibration, must necessarily cause considerable wear in the bearings and so tend to reduce very materially the life of the sweeper.

Although at high speeds of rotation the unbalanced centrifugal forces produce destructive effects, the actual movement of the device or machine can seldom be seen—often the movement is so slight as to be felt only by persons particularly sensitive to vibration. The problem in making a machine to measure these vibration effects is one of multiplying very minute motions so their magnitude may easily be determined. In early attempts at solution of the problem, mechanical levers and optical or light beam levers were used. These devices could not multiply motion of $25/1,000,000$ of an inch so as to give readable indications. However, by introducing the use of radio amplification it is now easily possible to multiply these vibrations 1,600,000 times. This will be evident when we consider that the energy received through the antenna of an average radio used in the home in the average day may be represented by the energy required by a fly in walking vertically up a wall for $\frac{1}{2}$ inch. Yet, this small amount of energy may be amplified in a radio receiver sufficiently to cause pictures to vibrate on walls of the home and to cause dishes to fall off shelves.

This tremendous amplifying power of standard radio devices is used in the Gis-holt Dynetric Balancing Machine to obtain easily readable exact indications of the minute vibrations produced by the destructive unbalances. For indicating the unbalanced spot on the rotating piece, a

(Continued to page 167)

JANUARY, 1942

V 2 III
Plastic Pancake Sports Hat Held on Head by Ribbon



Transparent hat shields eyes without blocking vision

Consisting of little more than a plastic disk, a hat for women's sports wear protects both the face and eyes. A band of ribbon drawn through two slits at the front holds the headpiece in place. It is made in five colors. The same material is used in a golf hat for both men and women.

L 10/4

Disabled Army Car Rides Cable To the Repair Crew

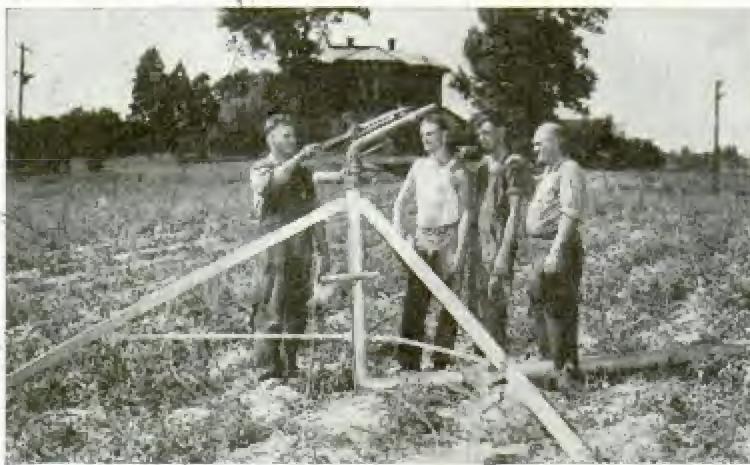
When one of their army trucks breaks down, men of the 33rd Division know what to do. They have devised a cableway over which to transport the truck quickly to the repair site so it can be put in running order again. A special sling is used as a carriage.



Disabled army truck riding cableway to repair shop

in Arizona

Rotating Water-Gun for Farm Irrigates 3½ Acres at Once



Revolving water gun, top, sprinkles broad area as shown by aerial view

Effective irrigation is accomplished in a simple manner with a revolving sprinkler developed recently. A giant water nozzle rotates as it shoots a long stream, covering three and one-half acres with an inch of water in about one and one-quarter hours. This water gun replaces 20 ordinary sprinklers which were coupled in series. Operated with the same equipment used in present spray systems, such as pump and portable pipe, the new unit can be moved easily from one field to another, and is said to offer large savings in labor and money.

Sheer Stockings Made of Cotton Ready for Silkless Era

In anticipation of a silk shortage, the U. S. Department of Agriculture has been at work for three years on the problems of producing cotton hosiery to replace silk. As a result, sheer, weblike mesh stockings

of cotton have been designed under the direction of David H. Young, textile technologist, and are ready for American hosiery manufacturers to put into mass production. More than 150 designs are offered, from sturdy sports weights to the finest mesh which can be worn with toeless evening shoes. The stockings are said to be far less likely to snag, wrinkle or fuzz than were those of the earlier years. About 89 percent of the full-fashioned knitting machines in this country, it is estimated, can knit cotton as well as silk, while 47 percent can handle nylon.

6/9/41

Enlarger With Light Has Metal Shield To Guard Eyes

Aiding close inspection of precision work, a combination magnifier and illuminated shield affords protection to the eyes. Available with a lens of either two or three inch diameter, the magnifier may be plugged into any outlet. It is made of lightweight alloy metal.



Magnifying lens and light are mounted in a single frame which shields the eyes while inspecting work



The CRAFTSMAN

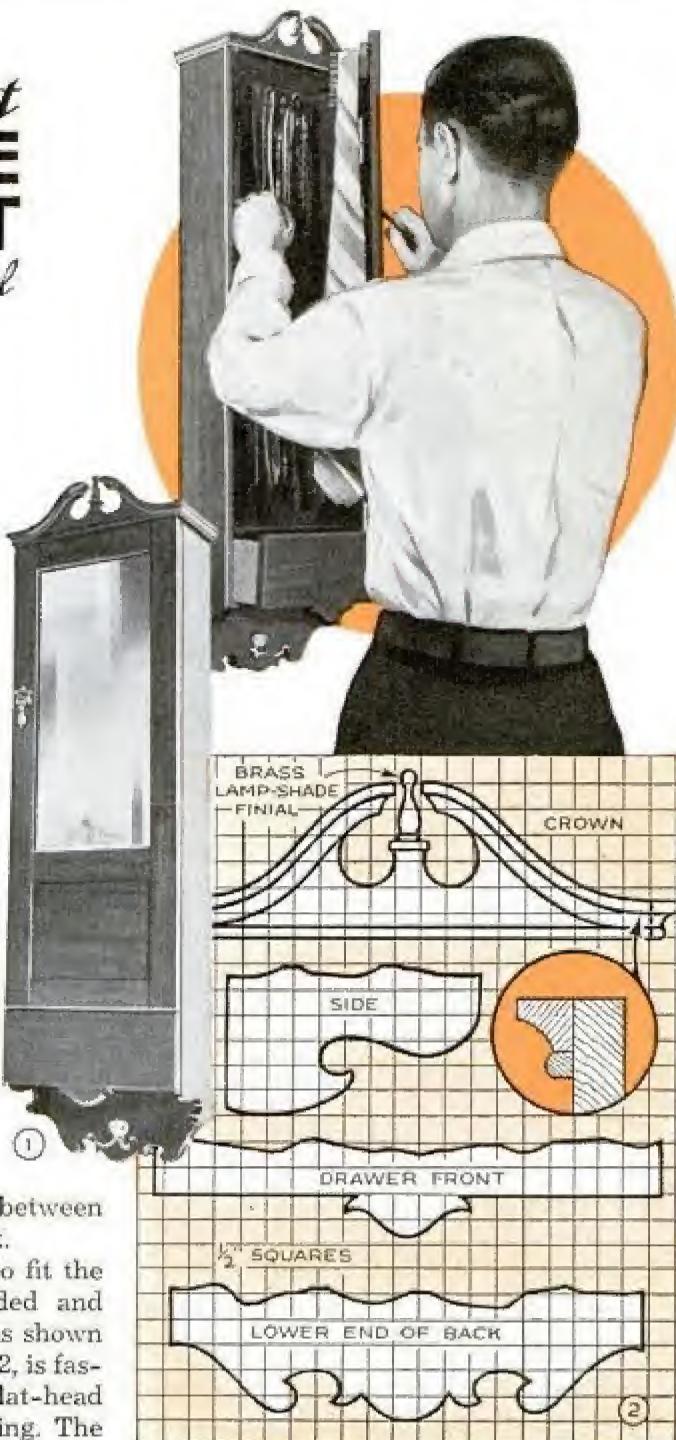
Mirror-front NECKTIE CABINET

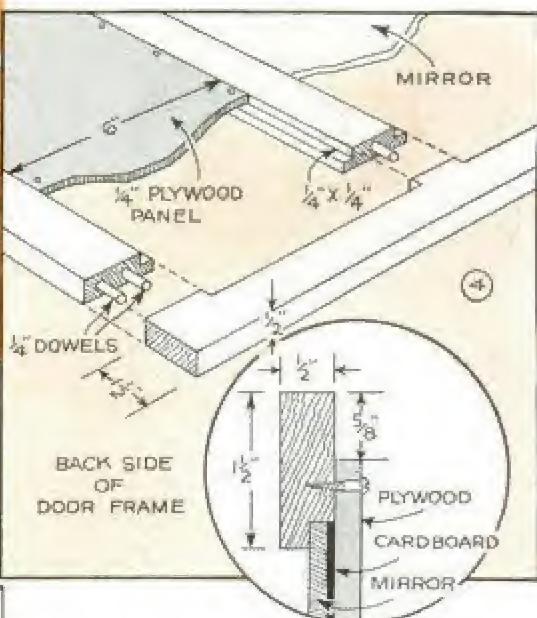
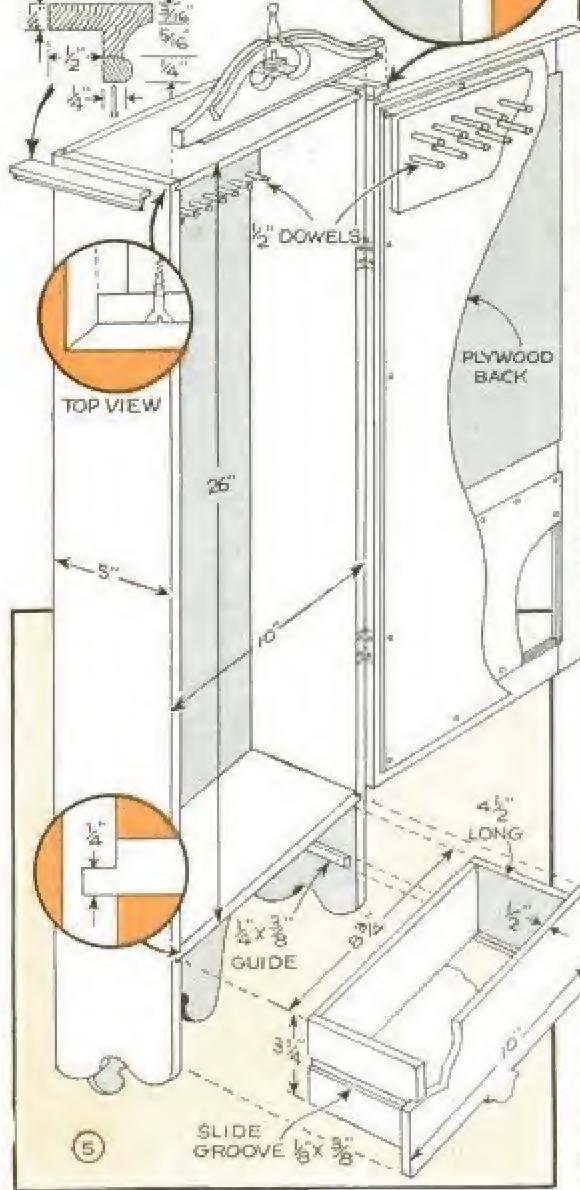
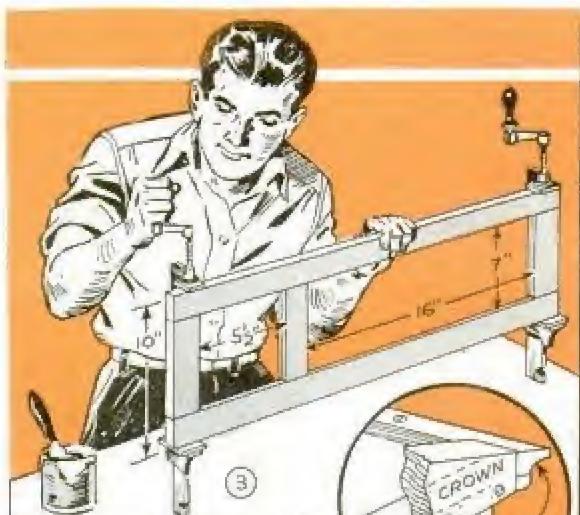
By J. Brunfield

THIS distinctive tie cabinet in Early-American style is an attractive piece of man's furniture. In it ties are hung separately from dowels. The front is fitted with a mirror, and a small drawer at the bottom is handy to keep cuff and collar buttons, tie clasps and pins. Two views of the finished cabinet are shown in Fig. 1, and constructional details are contained in Figs. 2 to 5 inclusive.

The cabinet is made of $\frac{1}{2}$ -in. stock, preferably walnut or mahogany. The parts are fitted together with dado joints, glued. The door is rabbeted to take the mirror and panel, the frame pieces being joined with $\frac{1}{4}$ -in. dowels. See Figs. 3 and 4. The back of the door is a piece of $\frac{1}{4}$ -in. plywood, fastened to the frame with round-head screws. The depth of the rabbet depends upon the thickness of the mirror you have, and also upon whether or not you wish to insert a piece of cardboard between the mirror and the plywood back.

The drawer sides are grooved to fit the drawer guides, which are bradded and glued to the sides of the cabinet as shown in Fig. 5. The open pediment, Fig. 2, is fastened in place with countersunk flat-head screws, which are covered by molding. The





molding on the sides is glued at the top and fastened with brads or small flat-head screws. The finial is a brass lamp shade finial forced on a dowel and fitted to the pediment. Pegs for hanging the ties are glued in holes drilled in the back and also in a separate piece of $\frac{1}{2}$ -in. stock, which is screwed to the inside of the door at the top. Where two or more rows of pegs are installed, the pegs should be staggered. If desired, a small clothes hook can be attached to the cabinet beneath the drawer as shown in Fig. 1. Exposed hardware may be bright brass or antique bronze, but all pieces should match.

The door pull at the edge is centered with the mirror, and a small friction catch, preferably of the "bullet" type, is placed at or near the top of the door. Give the cabinet a fine, rubbed finish, then fasten it to the wall with two long screws extending into a stud. Position of these screws should be centered at the top and bottom of the cabinet. If the

location of the cabinet is such that you do not have a stud directly behind it, you can use toggle bolts.

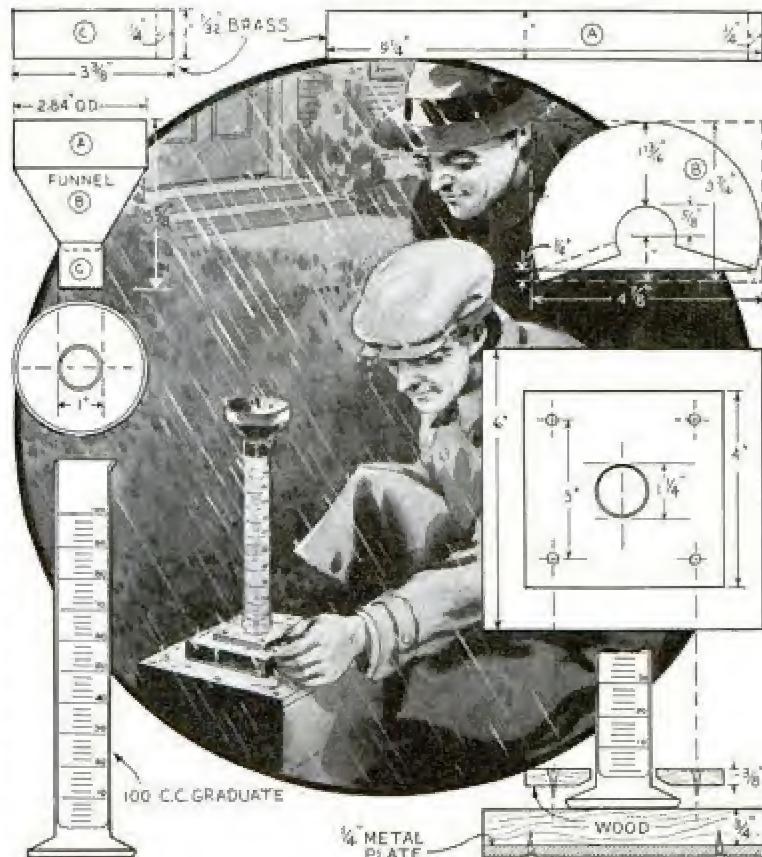
Removing Fruit Stains

Fruit stains can be removed from white woolens if the cloth is soaked 10 to 15 min. in a quart of lukewarm soapsuds water to which a tablespoon of hydrogen peroxide is added. Rinse in clear lukewarm water before drying.

Interesting Rainfall Gauge From Glass Graduate

A 100-cubic centimeter graduate provided with a funnel of correct design is ideally suited for accurate measurement of rainfall. With the funnel described, each division on the graduate indicates exactly $\frac{1}{100}$ inch precipitation. The three parts of the funnel are cut to size and shape and assembled with solder. Part C is designed for a 1-in. inside diameter graduate. The only critical measurement is the inside diameter of part A, which should be as close to 2.78 in. as possible. A substantial base is necessary to provide stability in high winds. The gauge should be placed in an open space away from buildings, trees, etc., and raised a foot or so off the ground.

—L. Marcelius, Chicago.



Lightweight Cistern Cover Can't Be Removed by Children

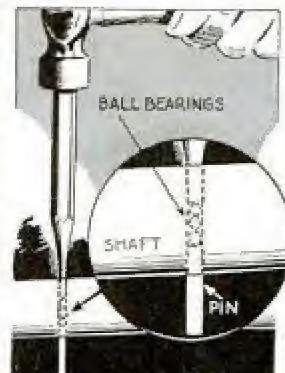
Although light enough to be lifted with one hand, this cistern cover cannot be raised high enough to remove it by small children who might tumble into the open-

ing. It consists of a cover disk of wood or sheet metal attached to an empty oil drum of about 20 gal. size.

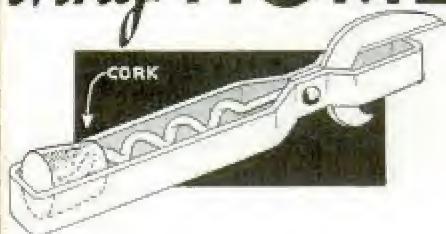


Pin Driven From Shaft Easily With Aid of Steel Balls

When removing a steel pin used to hold a wheel or gear on a shaft, a few small steel balls will aid in the work. First drive the pin with a punch as far as you can without the latter sticking. Then remove it and drop a few of the balls into the hole and again use the punch. With this method, it is possible to remove a long pin with a very short punch.

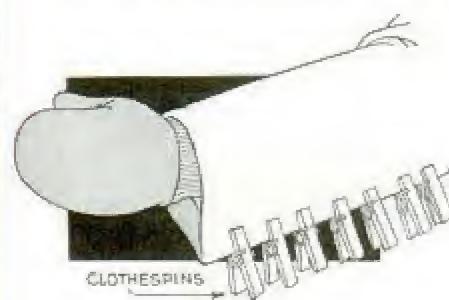


Solving HOME



↑ Using a cork to shield the screw part of a combination can opener eliminates any possibility of injuring the hands on the corkscrew when opening a can

← When wearing galoshes over suede shoes, you can protect the latter against soiling with old stocking tops. This also makes it easy to slip the galoshes on and off



↑ Clothespins clipped to your coat sleeve are easy to handle when wearing mittens while hanging out clothes in cold weather

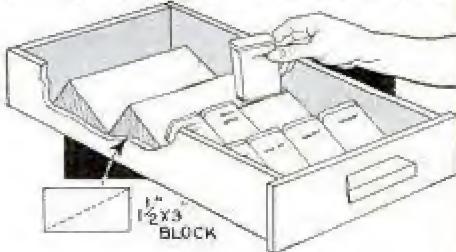
← Mounted under a window or on a wall, a window shade serves as an extension table if pulled out and hooked to a sewing machine while sewing large pieces of cloth



↑ Set in a shallow pan, a chopping bowl is easy to shift to various positions as the work progresses, yet it is supported solidly at all times regardless of the position

← You can keep a child from burning himself on a playroom radiator without decreasing its efficiency if you set a fireplace screen around the radiator

PROBLEMS



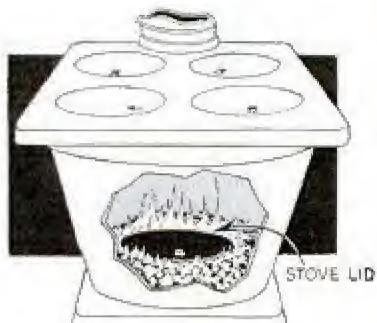
↑
Stored in a "stepped" drawer, spice tins are in plain sight for easy selection and removal. Wedge-shaped blocks nailed in the bottom of drawer serve nicely as steps

Two crossed pickets driven in the ground → as shown here will prevent a shrub at the side of a building from being damaged by snow-slides from the roof



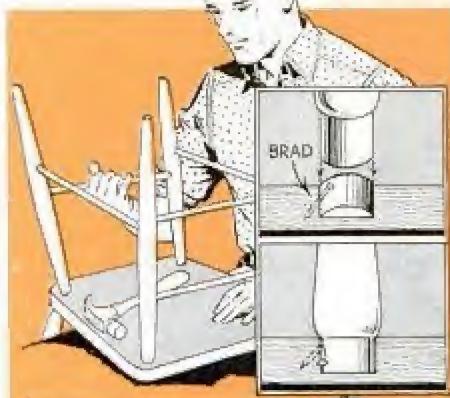
↑
Double stitches along each edge of a paper window shade will reinforce the edges and help prevent tearing or fraying

You can lock chair legs or rungs securely → in their holes by driving brads in the holes at an angle before forcing in the leg tenons. The brads bend and act as wedges



↑
If a basement laundry stove has too much draft, and closing the pipe damper causes the stove to smoke, you can check the fire by dropping an iron stove lid on the coals

Keeping an exposed clothesline pulley from → freezing fast is just a matter of nailing a section of old auto tire to the post so that it extends out over the pulley and line

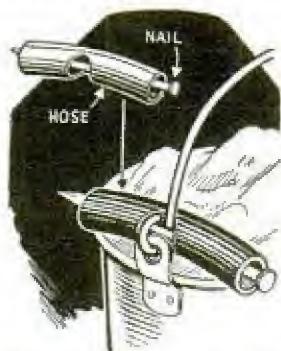


Rope Keeps Ladder From Slipping While Workman Is Raising It



A heavy ladder can be raised without danger of the bottom slipping, if a rope is tied to the lower rung. The rope is stretched out on the ground in position so that you can walk on it and hold the bottom securely.

Holding a Bucket Bail Vertically



When using a bucket where it is desirable to have the bail remain in a vertical position, an old piece of garden hose will do the trick. Just cut off a suitable length, notch one side at the center and then slip a

long nail or length of heavy wire through it as indicated in the drawing.

—Andrew Vena, New York City.

Making Basement Posts Easy to See

Support posts in a dark basement will be easier to see if you paint them as follows: Around each post wrap a spiral formed by 2-in. paper strips, then paint the post white between the strips. After the wrapping has been re-

moved, the spiral of white paint marks the post very clearly, giving it much greater visibility than it would have if given a solid coat of white paint.

Bowl Cover Protects Bike Seat

If you ride a bicycle to school or let it stand outside at home, the seat can be kept dry by merely slipping an oiled-silk bowl cover over it. When folded, the cover occupies only a small space and can be carried in the tool box.—E. L. Enochs, Glendale, Calif.



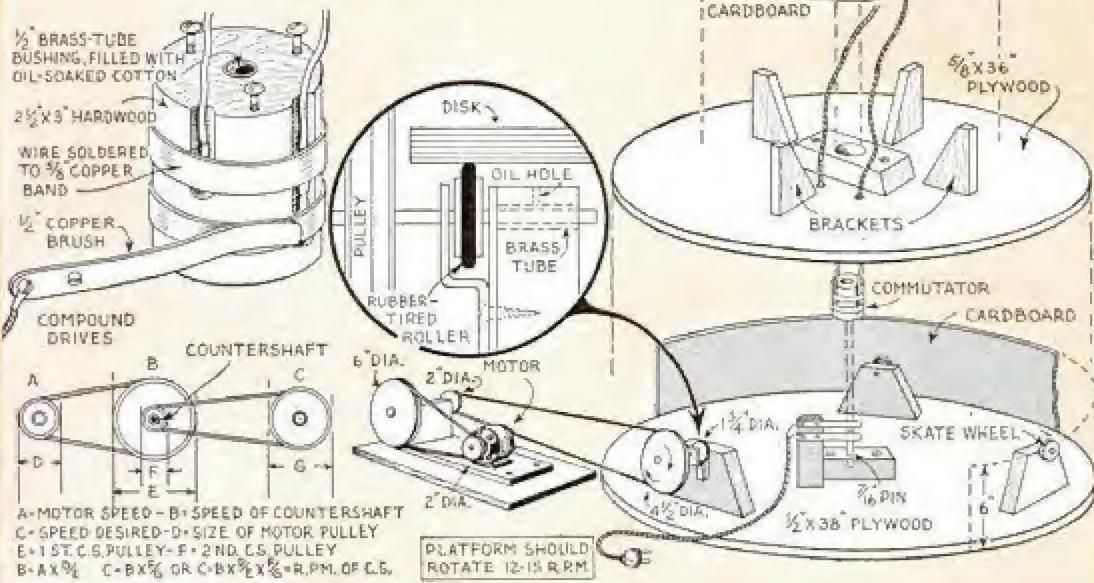
Non-Tipping Base for Table Tree From Inverted Funnel

A neat, attractive base to support a small table Christmas tree can be improvised from a tin funnel. Whittle the stem of the tree to fit the spout of the inverted funnel, and then turn a tapered wooden plug to fit tightly in the mouth of the spout. Bore a hole in the plug to take the stem of the tree and hold it in an upright position.

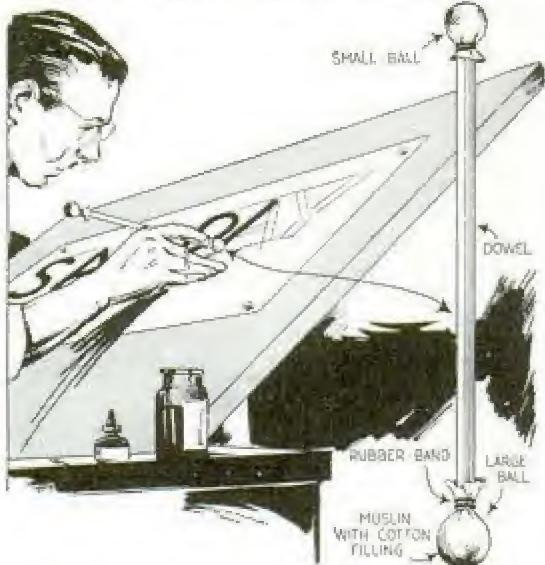


'ROUND and ROUND goes the CHRISTMAS TREE

ALL sides of your tree are displayed to advantage if you mount it on this rotating platform, which is driven by a small motor. Speed is reduced by using a jackshaft, V-pulleys and belts. The driving unit can be concealed in a small plywood house or church suitably painted to fit the "scenery." The platform consists of three disks, the center one bearing on three rollers mounted on brackets. Two of these rollers may be skate wheels. The third is a small driving wheel of the same diameter, and is rubber-tired. A centering pin on the lower disk engages a brass-brushed commutator, which is fastened to the underside of the center disk. The commutator is a hardwood drum having copper bands for slip rings, which convey current to a base outlet into which the tree lights are plugged. Copper brushes make contact with the slip rings.



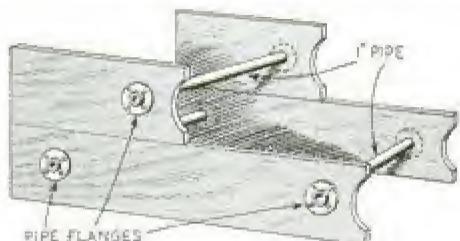
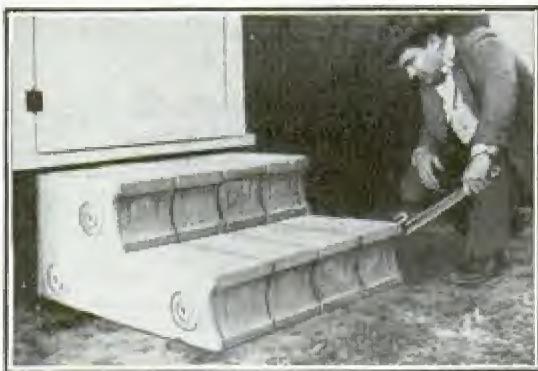
Substitute for Lettering Brush Handles Work Rapidly



Amateur card writers who wish to letter bulletins and signs easily without using expensive lettering brushes, can do the work rapidly by using a dowel padded at both ends. The pads are cotton covered with muslin and are held in place with rubber bands. When dipped into a solution of lamp black and turpentine, these brush substitutes do good work.

Steps Made From Concrete Blocks

Anyone who wants to build concrete steps in front of a door or porch and is not familiar with mixing concrete, can do a



good job by using concrete blocks. These can be purchased in any locality at a reasonable price. Steps made in this way are not likely to be affected by frost in the ground, and if one should crack, the entire assembly will not be damaged as is the case when the steps are poured. Hardwood end pieces, tied together by lengths of pipe run through the hollow centers of the blocks, hold the assembly together.

Preserving Volatile Solutions With Rubber Finger Cot

Bottles of solutions that have collodion bases, such as some household remedies and cements, in which the stoppers usually stick tightly when the solution dries on them, can be stoppered with rubber finger cots. These slip down over the bottles and exclude air, and can be removed easily.



Correct Speed for Circular Saws

Circular saws should not be run when filed down to a size where their edge speed is below 80 percent of their correct speed. Proper edge speeds for circular saws are 12,000 ft. per minute for soft woods and 10,000 ft. per minute for hardwoods. A 12-in. saw running 3,200 r.p.m. will have an edge speed of 10,000 ft. per minute.

Waterproofing Sheet Asbestos Used as Insulation

When sheet asbestos is used as insulation in locations where it may get wet, it can be waterproofed with water glass. This is mixed with an equal part of water and painted on the asbestos after it has been put in place. In addition to waterproofing the asbestos, the water glass also has a tendency to make it stronger and tougher.



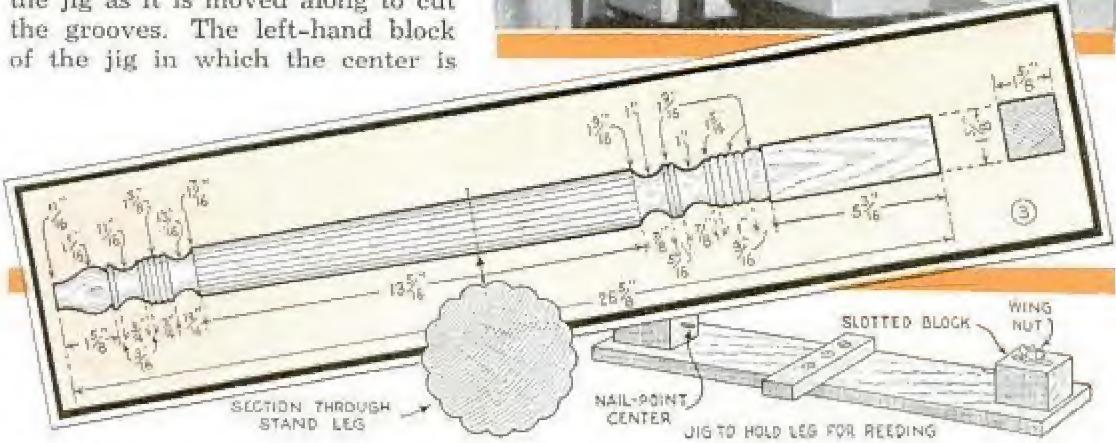
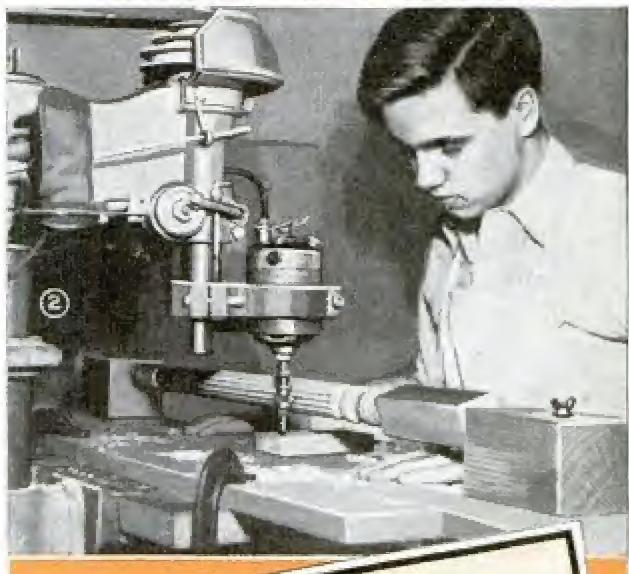
Sheraton NIGHT STAND *in cherry*

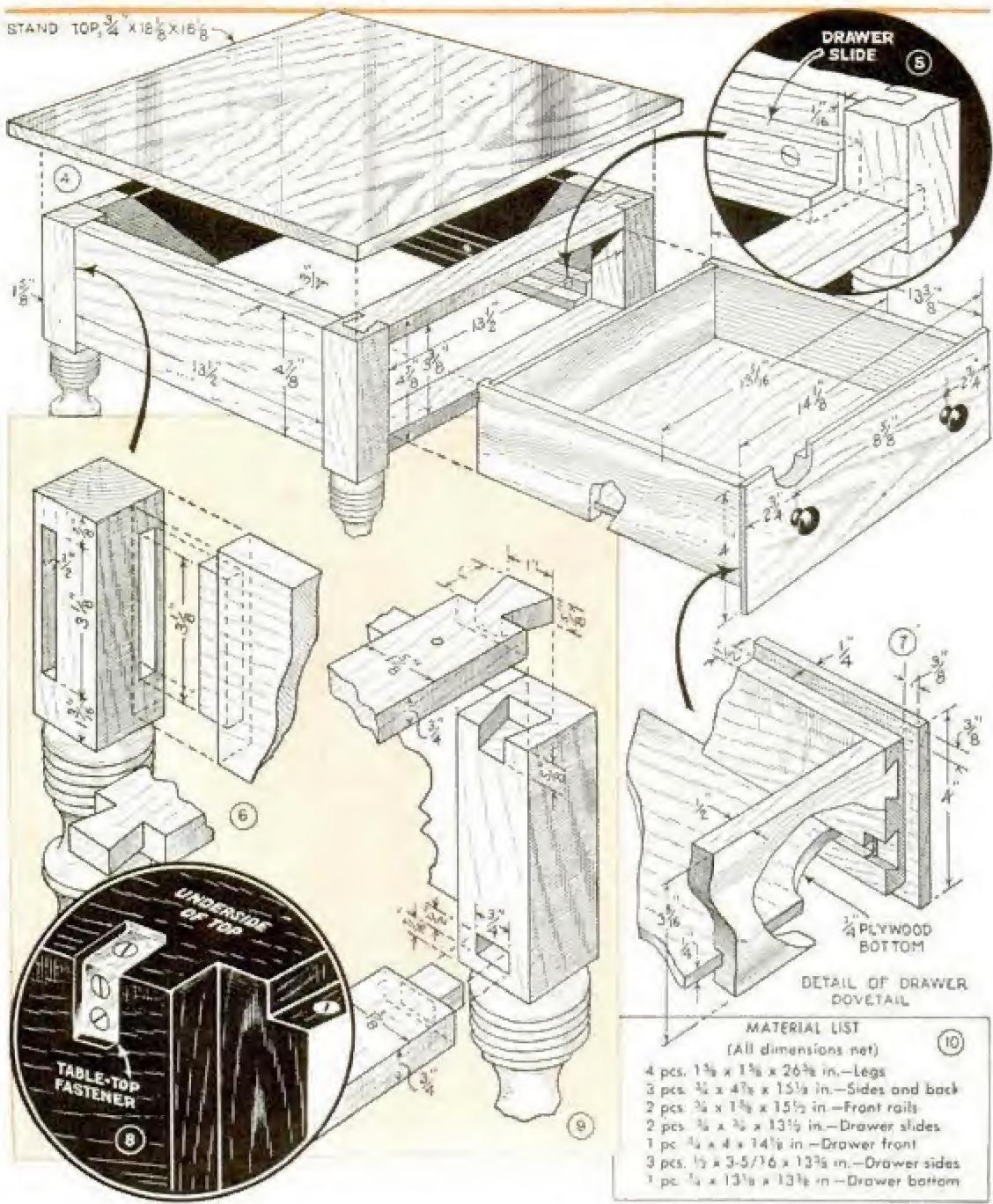
By W. B. Martin

COPIED from an early nineteenth century Sheraton design, this night stand, or side table, Fig. 1, was made of cherry, but it would look well in either mahogany or maple, depending on your room furnishings.

Begin construction by turning the legs to the shape and dimensions given in Fig. 3. Take particular care in turning the portion of each leg that is to be reeded so that the thickness and taper will be uniform on all four of them. The reeding may be omitted but as it gives the legs a slender and graceful appearance, the additional work is well worth while. The job of reeding can best be done with a shaper, but if you do not have one available, the work can be done in a drill press, or even a lathe. Fig. 2 shows a portable shaper clamped in a drill-press spindle and used for the job, but similar results can be had by using the shaper cutter on the drill-press spindle with an adapter.

A jig having two nail centers and an improvised indexing head is needed to hold a leg while reeding it. A strip clamped to the drill-press table serves as a fence to guide the jig as it is moved along to cut the grooves. The left-hand block of the jig in which the center is





driven is slotted for horizontal adjustment. It is held by a bolt and wing nut so that it can be pivoted sideways to take care of the taper on the work. If the reeding must be done in a lathe, the grooves are scraped by hand, using a tool made from an old file. The end of this is ground to the shape of the reed grooves with a fillet on each side to form one half of each reed. The reeding grooves are made in the leg by using the tool rest of the lathe as a guide for the scraping tool.

After completing the legs, they are mortised to take tenons on the ends of the side and rear rail pieces, Fig. 6. If necessary, the mortises can be cut by hand, first drilling and then removing the excess stock with a chisel. The mortises should be cut before forming the tenons on the rails as it is easier to cut the tenons to fit the mortises than it is to make the mortises fit the tenons. It is important that this work be done carefully as glue will never hold a loosely fitted mortise-and-tenon joint.

For the sake of rigidity, one of the front rails that form the drawer opening is dovetailed into the top of the front legs, and the other rail is mortised into them as in Fig. 9. The two drawer slides are simply rabbeted strips screwed to the side rails, Fig. 5, the screw heads being countersunk. Notice that the slides project slightly above the lower rail so that the drawer does not rub on it. Construction of the drawer is not difficult. The front piece is dovetailed to the sides, and the back piece fits in grooves cut in the front and sides. Time and labor can be saved here if the work has to be done with hand tools by making the dovetails extra large and using only two on each side. The drawer bottom is set in grooves cut in the front and sides, but not the back of the drawer, as in Fig. 7. Pulls for the drawer can be turned on a lathe or purchased as desired. A list of materials required is given in Fig. 10.

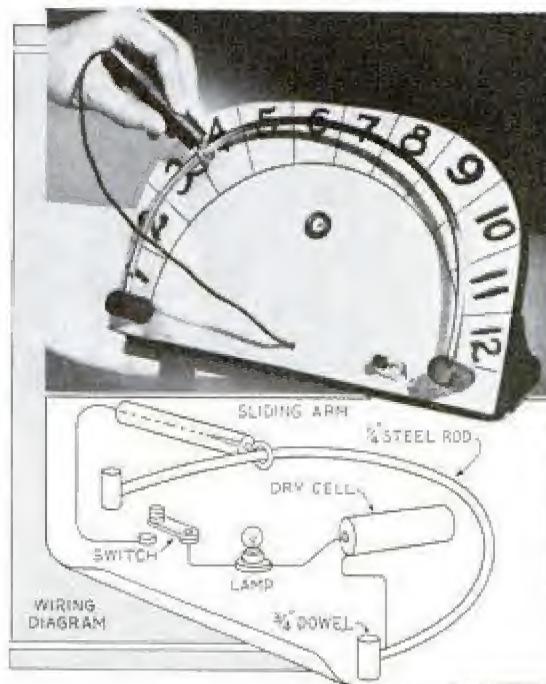
The stand top, Fig. 4, is made by gluing two or more pieces together. Use only the best glue for this work, and clamp the work securely until the glue dries. If this is not done, the joints may open and ruin your stand. The top is attached to the rails by means of table-top fasteners, Fig. 8. These are nothing more than iron angles drilled for the use of screws.

Finishing the table, Fig. 11, is a matter



of preference. Waxing was very much in vogue at the time the original was made, and as it continually improves with age, it should prove very satisfactory, and it is not difficult to apply.

Simple Game to Test the Steadiness of Your Nerves

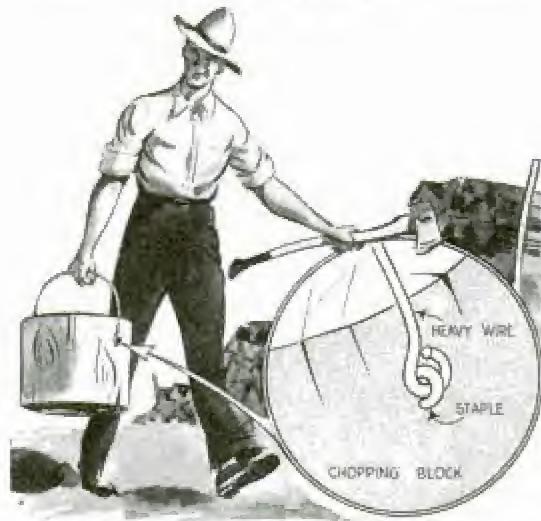


This simple game will provide a lot of fun for you and your friends. The object of the game is to see how far the sliding arm can be moved on the curved rod before touching the two together. When contact is made the lamp lights, making it easy to determine at what position contact was made. The electric indicator is a flashlight bulb and dry cell wired through a switch on the rear side of the game.

Use Good Paint Brushes

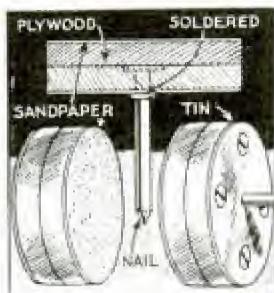
Don't use cheap paint brushes if you wish to avoid brush marks. Better and faster work can be done with a good 2 or 2½-in. brush on woodwork than with a cheap 3 or 3½-in. one. For overnight protection, immerse brushes in the paint, if sufficient paint is present to cover bristles right up to stock. Otherwise, wash brushes in thinner and immerse in thinner up to stock.—Harold J. Ashe, Los Angeles, Calif.

Wire Handle on Chopping Block To Carry It Easily



Much of the difficulty of moving a large chopping block from place to place can be avoided by fitting it with a carrying handle. The handle can be made from a length of heavy wire. This is bent to the shape of a bucket bail and fastened to each side of the block with a large staple.

Inexpensive Sanding Disks Made From Plywood and Tin



Small sanding disks for use on a drill press, lathe, flexible shaft, etc., are made easily from plywood disks. After cutting these to size, make a tin or sheet-metal disk to match. Drill one wood disk and countersink the hole to take a nail. Then punch the metal disk for the nail and solder the two together. Next drill four screw holes through both the metal and the wood disk for attachment of the second wood disk to which the abrasive paper is glued.

—L. H. Young, Pismo Beach, Calif.

Woods to Use for Patterns

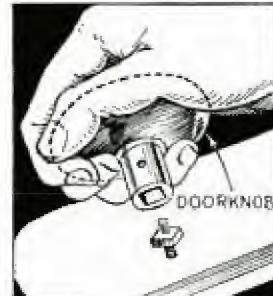
The ideal wood for pattern-making is clear, straight-grained and free from knots. Air-dried stock is better than kiln-dried because it is stronger, more elastic and does not have drying strains found in kiln-dried

stock. Air-dried poplar and mahogany are ideal pattern-making woods as they have all of these qualities.

—Paul H. Graham, Plainfield, Conn.

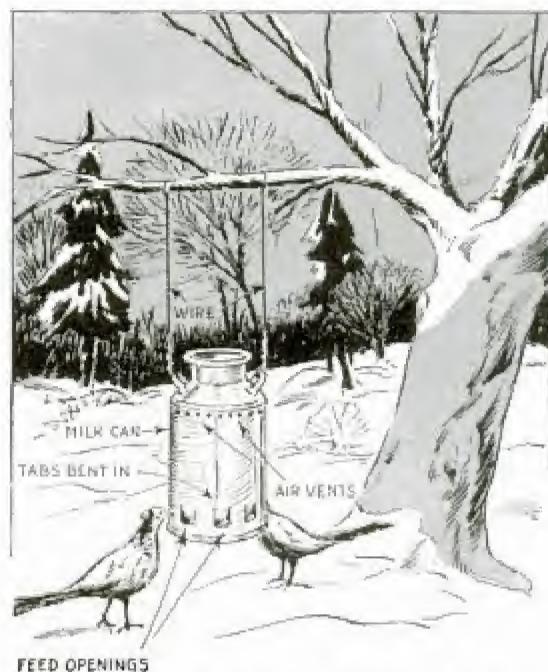
Doorknob Serves as a Wrench For Small Stove Bolts

In assembling articles with small stove bolts, one mechanic found a door knob handy for tightening the nuts. The square hole in the socket of the knob fits over the nuts.



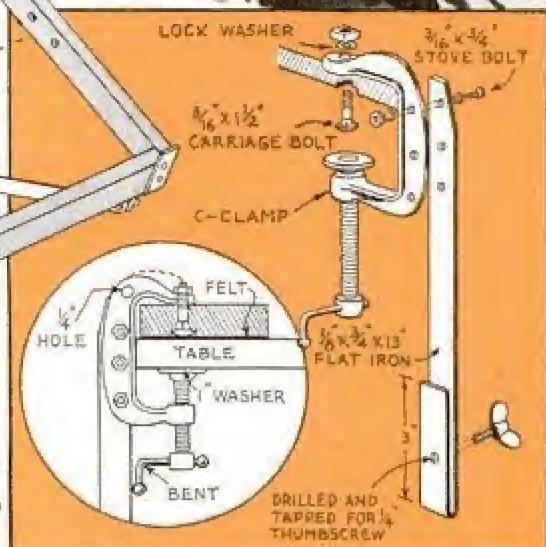
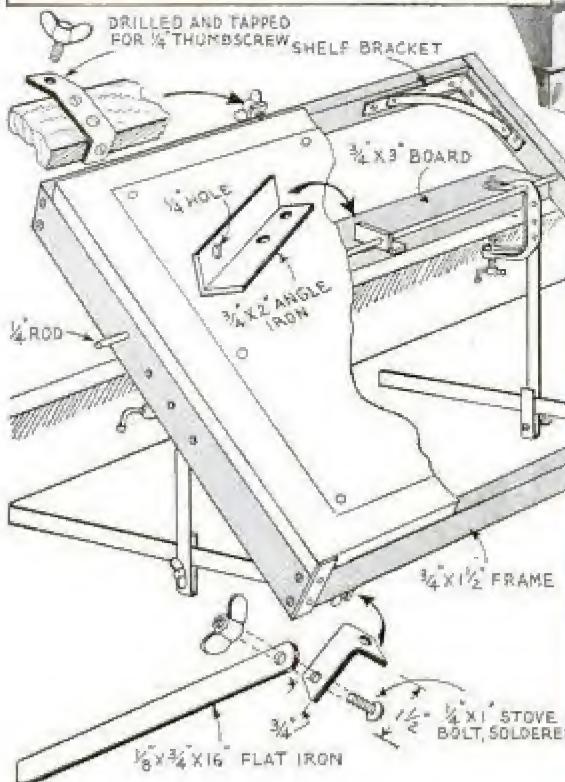
Pheasant Feeders From Milk Cans Keep Out All Rodents

Used by a Wisconsin gun club, this self feeder for pheasants and other game birds is made from an old milk can. Supported from a tree limb by means of two wires, the can is held above the ground so that rabbits and other rodents cannot reach them. Tabs are cut around the can near the bottom and then pushed inward to provide the feed openings. A number of holes drilled around the upper rim of the can provide air vents to keep the grain from accumulating moisture and freezing.



Adjustable Drawing Board Clamps to Table

Students and others who must do some sketching at home but have no regular drawing table, will find this board very useful as it can be clamped quickly on the edge of a table, desk or shelf, and can be adjusted to any desired height or angle. When not in use, it can be folded up compactly and put away in a small space. The frame that supports the board is made of hardwood assembled with glue and screws and reinforced at the corners with shelf brackets. The board is held in place by a thumbscrew as shown

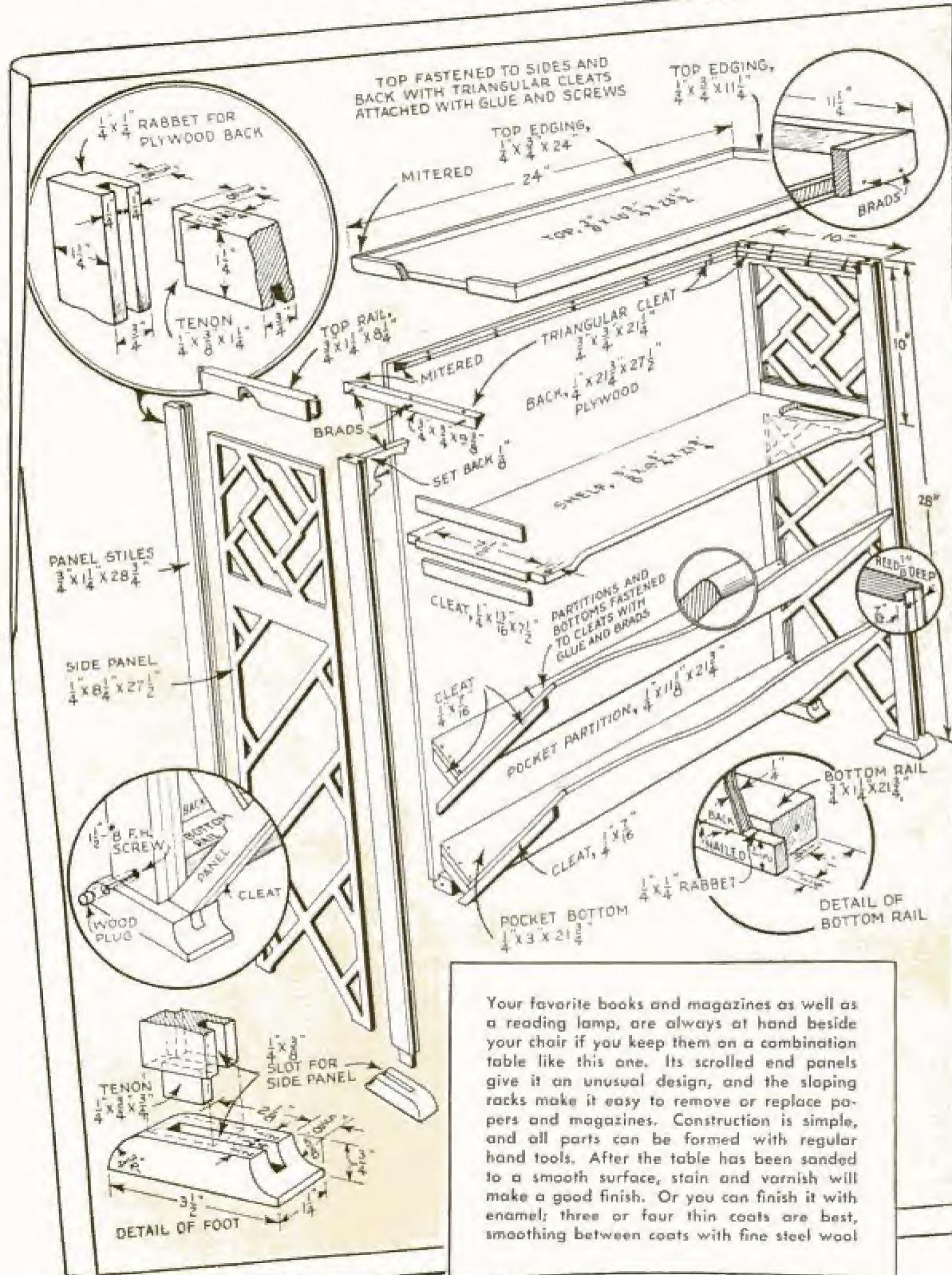


Heats to Temper Homemade Tools Checked With Solder

The home mechanic who makes up small tools from drill rod or similar steel, will find that the following methods of gauging tempering heats and hardening the metals produce very accurate results. Instead of quenching the metal in water, heavy machine oil or boiled linseed oil is used, the tool being heated to a very bright cherry red, but below a white, sparkling heat. This is necessary as the oil quenches slower than water, giving the required hardness and increasing the strength and toughness. After this preliminary hardening, the tool is polished for some distance back of the working edge. Then it is heated slowly by

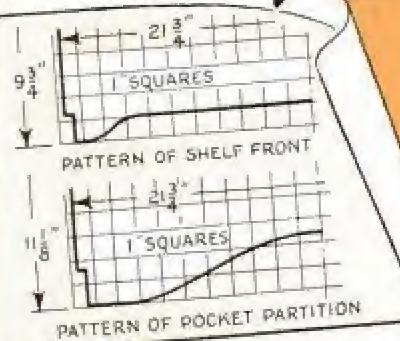
applying a blowtorch flame about 1 in. back of the working edge until the metal just begins to change color, after which it is tested by touching a piece of half-and-half solid wire solder to the heated portion. If the solder melts instantly, remove the tool, and as the heat works toward the edge, keep testing with the solder. When this barely melts when pressed firmly on the edge, quench the tool in water instantly and it will be of the right hardness for working in wood, leather and soft metals. For punches, cold chisels, etc., the metal should be just hot enough to melt the solder after a couple of light rubbing strokes.

CHAIRSIDE TABLE



Your favorite books and magazines as well as a reading lamp, are always at hand beside your chair if you keep them on a combination table like this one. Its scrolled end panels give it an unusual design, and the sloping racks make it easy to remove or replace papers and magazines. Construction is simple, and all parts can be formed with regular hand tools. After the table has been sanded to a smooth surface, stain and varnish will make a good finish. Or you can finish it with enamel; three or four thin coats are best, smoothing between coats with fine steel wool.

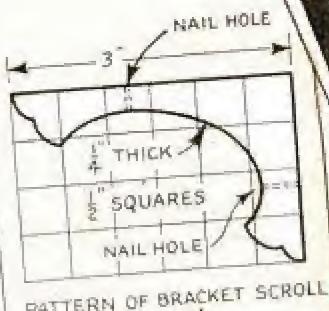
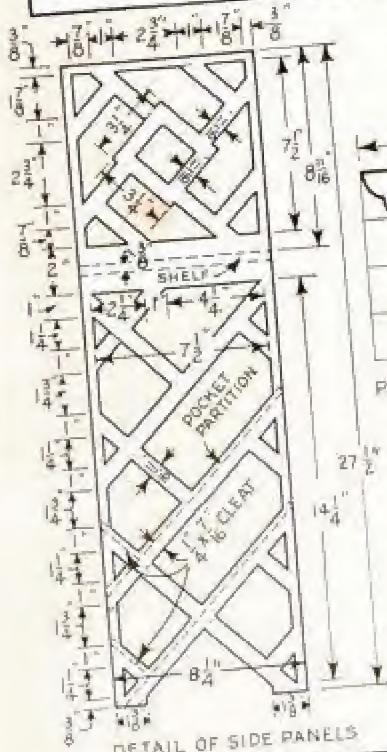
holds your magazines



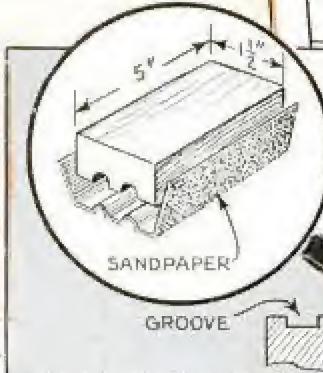
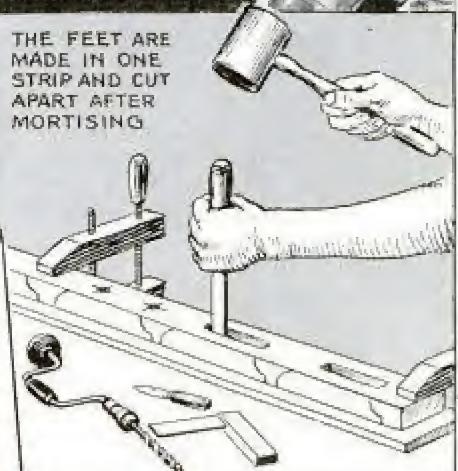
MATERIAL LIST

- 1 pc. $38 \times 10\frac{1}{4} \times 23\frac{1}{2}$ in.—Plywood—Top
- 2 pcs. $1\frac{1}{4} \times 32 \times 12$ in.—Poplar—Top edging *
- 2 pcs. $1\frac{1}{4} \times 32 \times 25$ in.—Poplar—Top edging *
- 4 pcs. $34 \times 1\frac{1}{4} \times 28\frac{1}{4}$ in.—Poplar—Panel stiles
- 2 pcs. $34 \times 1\frac{1}{4} \times 8\frac{1}{4}$ in.—Poplar—Top rails
- 2 pcs. $34 \times 8\frac{1}{4} \times 27\frac{1}{2}$ in.—Plywood—Side panels
- 2 pcs. $34 \times 8\frac{1}{4} \times 9\frac{1}{8}$ in.—Poplar—Triangular cleats
- 1 pc. $34 \times 3\frac{1}{4} \times 21\frac{1}{4}$ in.—Poplar—Triangular cleat
- 2 pcs. $1\frac{1}{4} \times 2 \times 3$ in.—Plywood—Bracket scrolls
- 1 pc. $\frac{3}{8} \times 9\frac{1}{4} \times 21\frac{1}{4}$ in.—Plywood—Shelf
- 4 pcs. $1\frac{1}{4} \times 13\frac{1}{16} \times 7\frac{1}{2}$ in.—Plywood—Shelf cleats
- 2 pcs. $1\frac{1}{4} \times 11\frac{1}{8} \times 21\frac{1}{4}$ in.—Plywood—Pocket partitions
- 2 pcs. $1\frac{1}{4} \times 3 \times 21\frac{1}{4}$ in.—Plywood—Pocket bottoms
- 4 pcs. $1\frac{1}{4} \times 1\frac{1}{4} \times 3\frac{1}{2}$ in.—Poplar—Feet
- 1 pc. $34 \times 1\frac{1}{4} \times 21\frac{1}{4}$ in.—Poplar—Bottom rail
- 1 pc. $1\frac{1}{4} \times 21\frac{1}{4} \times 27\frac{1}{2}$ in.—Plywood—Back
- 4 pcs. $1\frac{1}{4} \times 7\frac{1}{16} \times 14$ in.—Poplar—Partition cleats *
- 4 pcs. $1\frac{1}{4} \times 7\frac{1}{16} \times 3$ in.—Poplar—Bottom cleats *

* Allowance in length for fusing or mitering

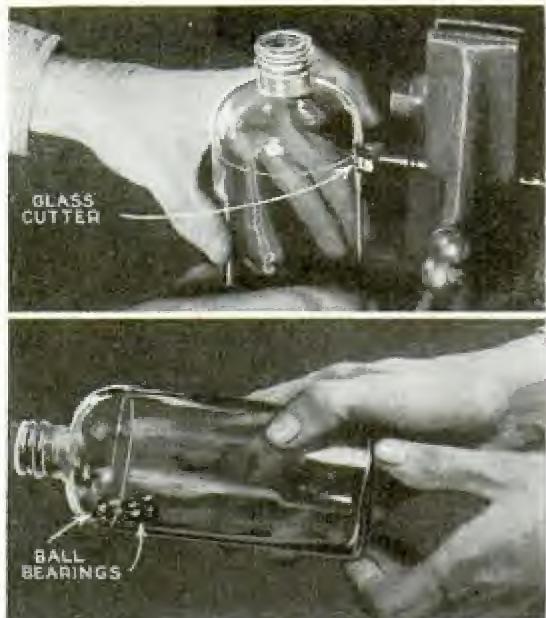


THE FEET ARE MADE IN ONE STRIP AND CUT APART AFTER MORTISING



BEADS ARE SHAPED ON THE EDGES WITH A FORMED SANDPAPER BLOCK, AFTER GROOVING THE CENTER

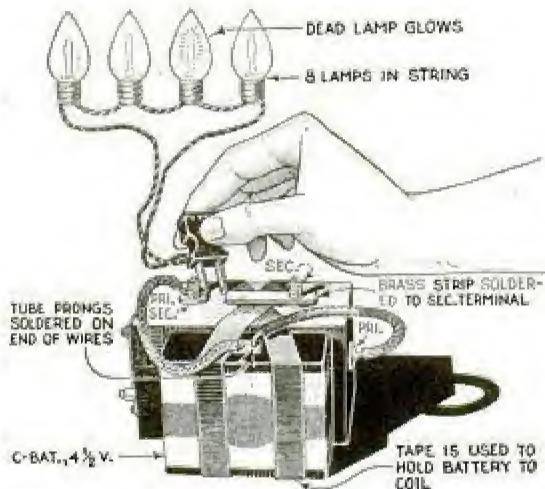
End of Bottle Removed Easily With Aid of Steel Balls



The next time you want to remove the top from a bottle, try the following method: First score the outside surface of the glass with a glass cutter. Then place six or eight ball bearings inside the bottle and shake up and down so that the balls strike gently at the scored line as indicated in the lower photo. If done correctly, the tapping action of the balls will cause the glass to break cleanly. Balls of $\frac{1}{8}$ to $\frac{1}{4}$ in. in diameter are about the right size.

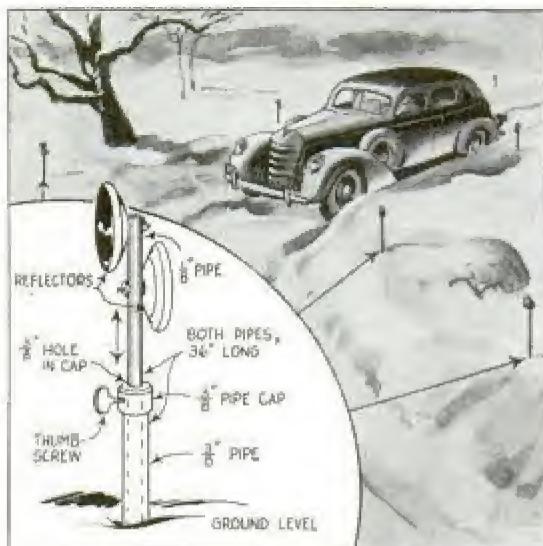
Tester Locates Defective Bulb In Series Tree Lights

You can find a burned out bulb in a series-wired string of Christmas-tree



lights quickly by using a Ford spark coil and a $4\frac{1}{2}$ -volt C-battery. The battery is connected to the primary winding of the coil, and a brass strip is connected to the secondary-winding terminal of the coil. The strip should be long enough so that the prongs on the plug of the light string will bridge a gap between the strip and the primary-secondary terminal of the coil. You can solder radio-tube prongs to the wires that connect the battery to the coil so that they can be inserted into the battery socket when using the coil, or you can put a switch in one of the wires. The high-tension current produced by the coil with a $4\frac{1}{2}$ -volt battery will jump the burned element of the defective bulb and cause it to glow, but will not light the good bulbs. Do not use a stronger battery as it might damage the good bulbs.

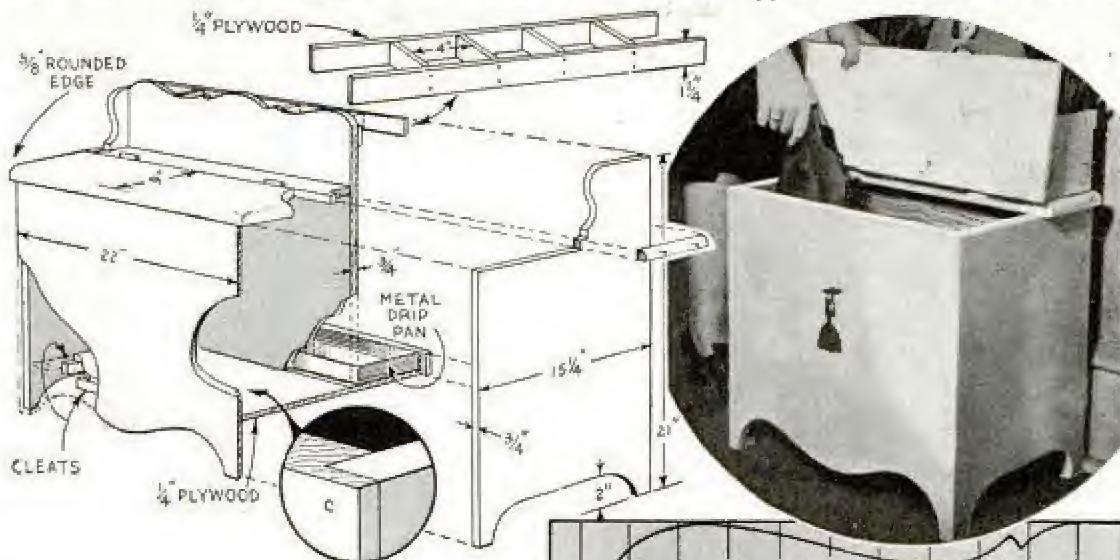
Private Driveway Markers Adjust Above Deep Snows



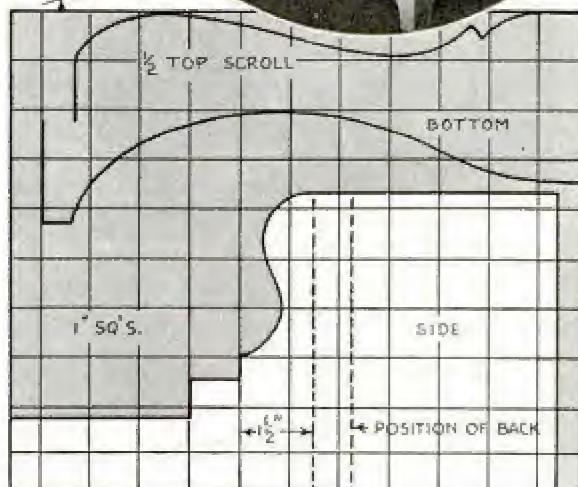
Adjustable for height, the reflectors of these driveway markers can be extended in winter to reach above the snow and lowered in summer to be inconspicuous in the landscaping. In localities of average snowfall, an extension of 3 ft. should be sufficient. The use of brass pipe is recommended for long service. Holes for the markers should be dug in the ground as the pipes are likely to fill with soil if they are driven. Leave the bottom ends of the pipes uncapped so moisture can drain out.

►A small paintbrush is very handy for cleaning in the corners of floors or steps.

Hallway Chest Stores Rubbers and Umbrellas



Besides serving as a seat when putting on your rubbers and overshoes, this hallway chest is an adequate storage space, in addition to providing a convenient place to set umbrellas on end. Made of $\frac{3}{4}$ -in. pine or plywood, the chest is assembled with finishing nails set and puttied. The front is rabbeted to take the ends, both the ends and front being scrolled at their lower edges. To provide space for umbrellas, the back is set in $4\frac{1}{2}$ in. from the rear edges of the ends where it is butted and nailed. The back reaches only to the bottom of the chest which is supported on cleats 3 in. above the floor. The bottom extends beyond the back to form the bottom of the umbrella stand. A wood strip across the back at this point forms a well for a metal drip pan. The upper part of the stand is formed with plywood strips as shown, and is screwed to the back of the chest near



the scrolled top. The cover is hinged to a 2-in. strip nailed to the ends and back. Rounded edges of the cover give a neat effect, which is carried to the rear edge by strips of molding nailed to the end pieces. The ornament on the front of the box is a decalcomania transfer.

Rubber Band Can Be Used as a Temporary Curtain Rod

Next time you want to put up a curtain on a small window or cupboard opening, and there is no curtain rod available, just use a heavy rubber band. You can slip the band through a safety pin so that it can be run through the curtain hem easily. Then stretch the band across the opening and slip the ends over a couple of L-hooks.

If your medicine cabinet is set into the wall, cut a slit in the bottom to drop used razor blades between the walls.

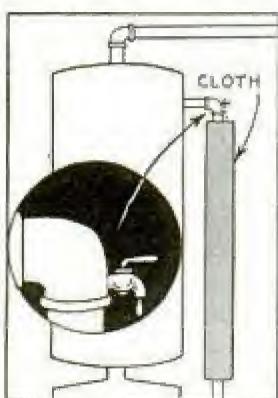


"Rubber Glove" From Inner Tube Protects Trapper's Arm



Trappers and fishermen who have occasion to reach under water to attend traps or fish lures during cold weather, will find this rubber glove a comfortable protection for their arm and hand. Finger holes are cut in one end of a section of inner tube, which is then cemented shut. The holes should be small enough to make a snug fit around the fingers so water cannot enter.

Simple Humidifier on Hot Pipe Moistens Air in Home



with a highly absorbent cloth. Open the cock so that water drips on the cloth just enough to keep it damp. Heat from the pipe will evaporate the moisture and dissipate it into the room. The amount of

water that can be evaporated in a day will depend on the temperature of the pipe and the length of the portion that is wrapped with the cloth.

—J. F. King, Williamstown, Mass.

Index on Side of Storage Drawer Records the Contents

Instead of rummaging through the storage drawer every time you are looking for something that might be in it, attach a card to the side of the drawer and then write on it the name of each article as it is stored. Reference to the card will show whether or not the article you are looking for is in the drawer.



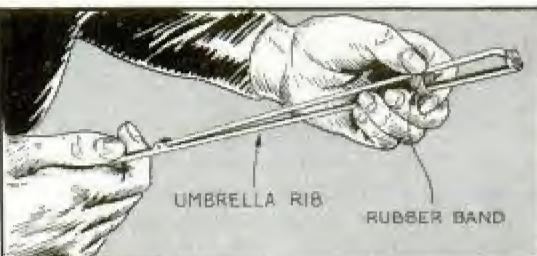
Rubber Prevents Loss of Badge

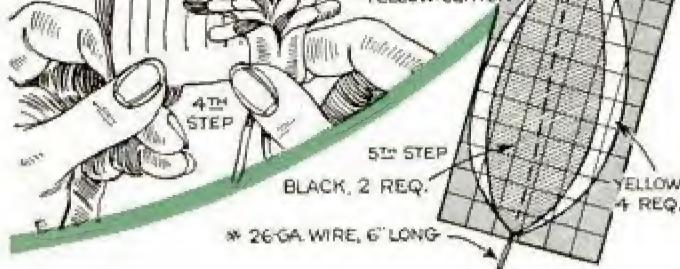
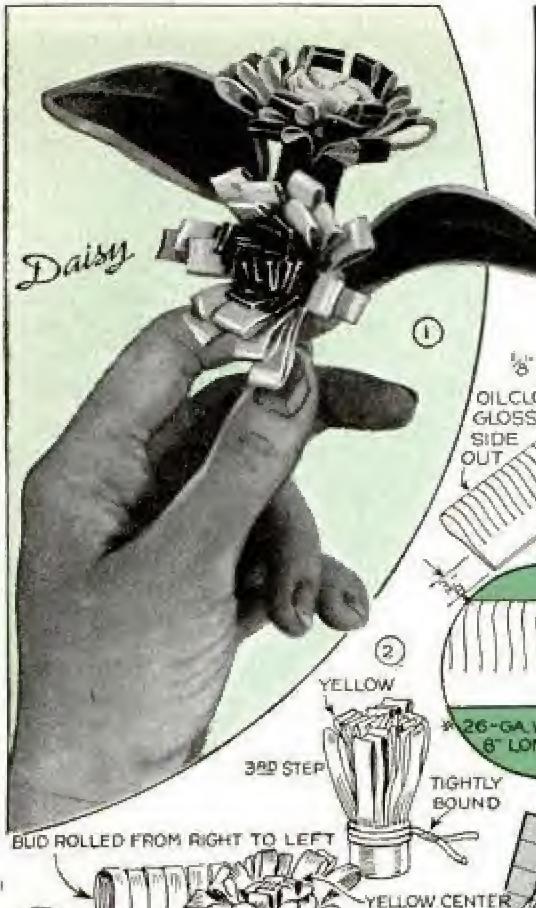


Hunters and others who must wear a license badge can help insure against its loss by placing a thin slice of sponge rubber inside the badge under the pin. In this position, the rubber provides friction against the fabric of the clothing so that the pin cannot work loose easily.

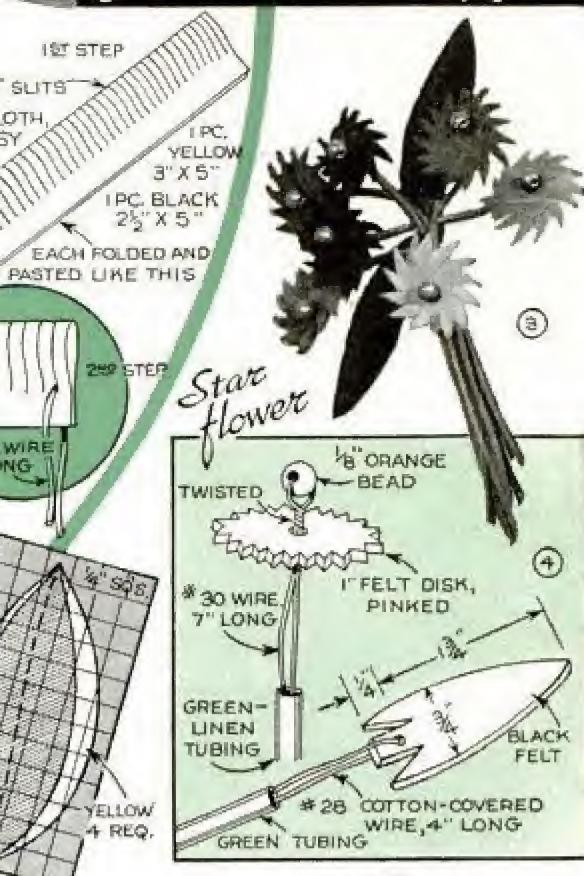
Long "Finger" to Insert Parts Into Hard-to-Reach Places

An old umbrella rib is handy to hold nuts and other small parts for inserting them into places that cannot be reached with the fingers. A rubber band snapped around the rib as indicated provides tension to grip the part.





CORSAGES of oilcloth, felt and raffia

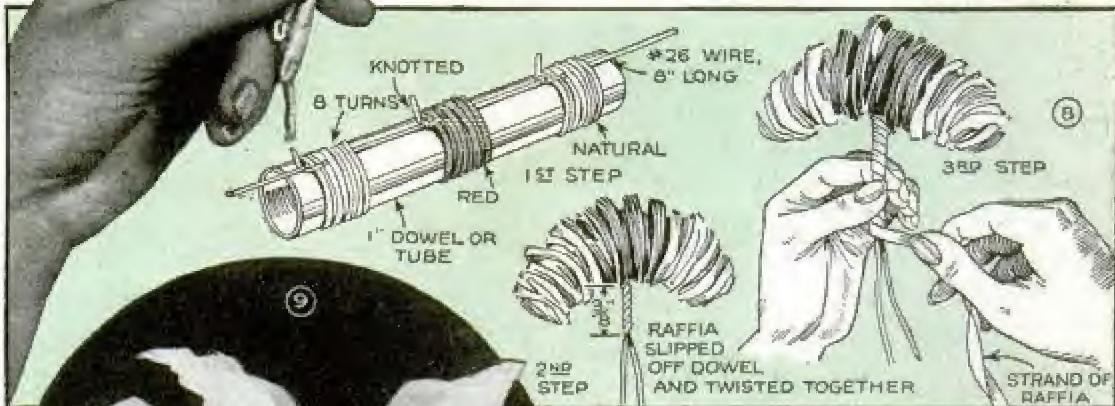


ARTIFICIAL flowers that provide permanent corsages for your garments are easy to make from simple materials that offer an endless variety of colors and combinations. For example, the daisy, Fig. 1, is shaped from small pieces of oilcloth and fine wire. The five steps in forming it are detailed in Fig. 2. Note that the wire stem is looped over the slotted oilcloth before starting to roll the bud, and that the wire leaf stem is placed between the cut-outs before pasting them together.

The little bouquet of star flowers, Fig. 3, shows what can be done with small pieces of felt and a few beads. Felt disks are best cut by following a cardboard pattern, after which the edges are pinking as in Fig. 4, with sharp scissors or a razor blade. A sim-



⑦

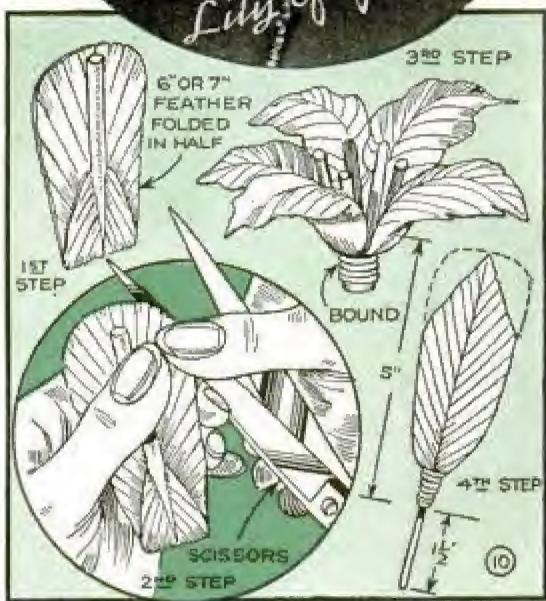


ilar bouquet of square flowers is shown in Figs. 5 and 6. These are assembled in the same manner as the star-shaped ones, with the exception of the leaves, which are $\frac{1}{4}$ by 7-in. strips of felt, folded once and bound to the stems with yarn of a matching color.

Natural and red colored raffia was used for the spiral flower, Figs. 7 and 8, although other materials such as ribbon, string or heavy yarn could be used. Before starting to wrap the raffia, mark a straight line on the tube lengthwise. This will serve as a guide in keeping the 8-in. length of wire



Lily of feathers

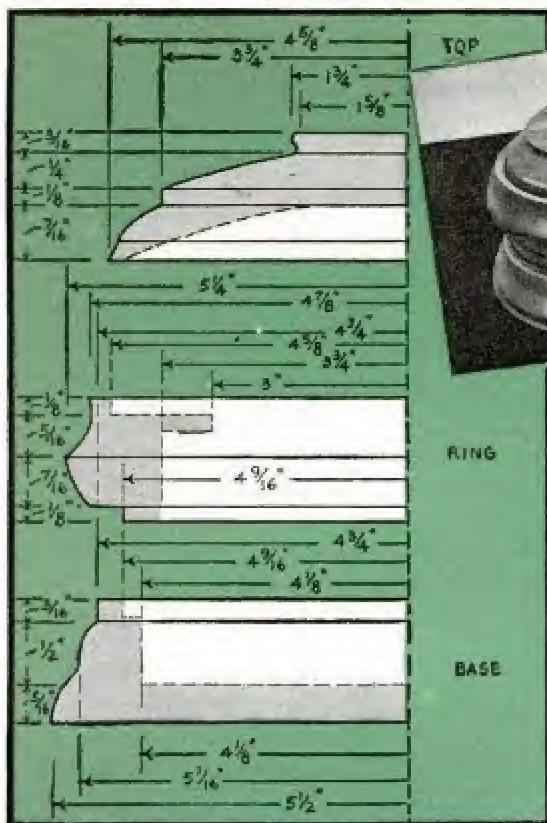


straight. In wrapping the stem, the wire ends are bent up and wrapping continued over them and back up the stem to cover any sharp edges. Use a large needle to slip the end of the raffia under the wrapping.

Ornamental feathers also make excellent material for graceful flowers. The lily in Fig. 9 is a good example. For this, dyed chicken feathers were used to form the petals. While the center of the flower may be of the same color as the petals, a more striking effect is produced by using a contrasting color. Steps for shaping the feather petals are given in Fig. 10. After waving the edges with scissors, the feathers are bent slightly outward by cracking the quill with the thumbnail every quarter inch. Short lengths of wire are wound around the base of each petal after which they are wrapped with crepe paper and bound together. A tight wrapping of silk yarn, Fig. 11, completes the stem covering.



A Turned Vanity Powder Box in Three Pieces



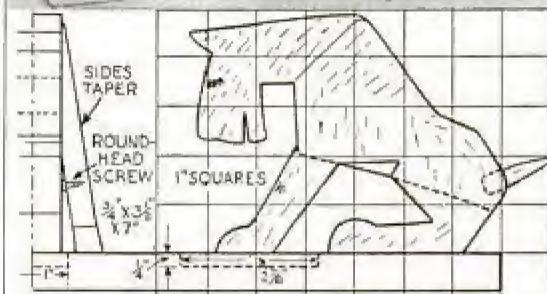
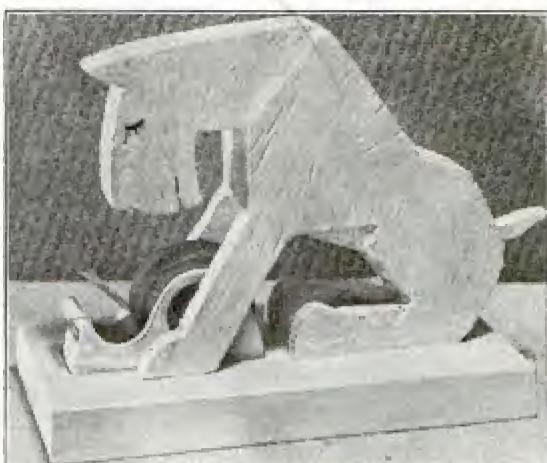
Making a neat appearance on the vanity, this three-piece box provides a handy place to keep face powder and a puff. It is turned from walnut and consists of a top, ring and base, the ring being shaped to slip over an ordinary powder box. It is only necessary to remove the top for use

Terrier Cutout on Counter Guards Cellulose-Tape Holder

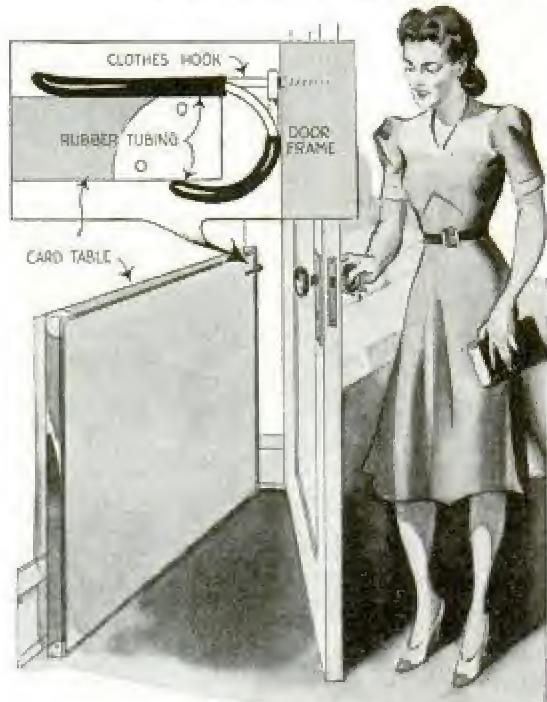
Besides providing a place for the cellulose-tape dispenser on a store counter or desk, this terrier cutout also serves as a novel decoration. The body is cut from $\frac{3}{4}$ -in. stock and the legs are scroll-sawed from $\frac{3}{8}$ -in. plywood, all edges being roughened by pushing the pieces lightly against the saw blade. After mortising the base, a round-headed screw is driven on the inside of each front leg to help lock the dispenser in place.

Protecting Paint Overnight

When you stop painting for the day, pour a small amount of turpentine or paint thinner over flat paint; boiled oil over outside paint; boiled oil, turpentine or enamel oil over enamel. It will prevent a scum forming. Scum will cause the paint to be full of small slugs next day, preventing a smooth job. If slugged up or if grit accumulates in paint, strain into a clean bucket through cheesecloth or a silk stocking.



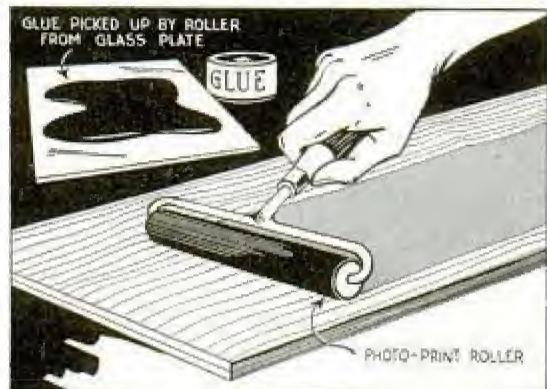
Hook Aids in Storing Card Table Behind a Door



If you are in the habit of storing a card table behind a door where it usually slips and falls down on the floor, you can avoid this trouble by use of a clothes hook. The hook is merely driven into the wall so that the folded table can be slipped into it as indicated. Rubber tubing stretched over the prongs of the hook will prevent marring the surface of the table.

Photo-Print Roller Spreads Glue Over Large Surfaces

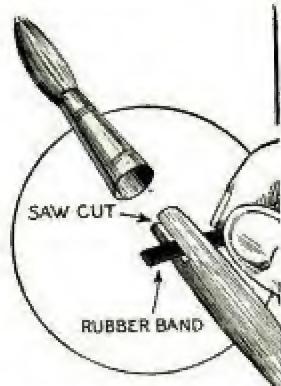
It is not a difficult job to apply glue to a large flat surface if you use an old photo-print roller. If such a roller is not at hand, you can make one by slipping a piece of



smooth garden hose over a large dowel and fitting it with a handle. To use the roller, the glue should first be applied to a glass plate or other smooth surface so that it can then be rolled out and picked up uniformly on the roller.

Keeping Artists' Brushes Tight On Their Handles

When the handle of an artist's brush has a tendency to loosen and slip out of the ferrule, the trouble can be avoided as shown. Just make a saw cut in the end of the handle, insert a short piece of rubber band and then push the ferrule back onto the handle. The rubber makes a resilient wedge to keep the ferrule tight.

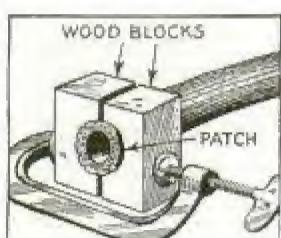


Rubber Band Around a Pencil Makes It Stay in Pocket

Difficulty in making a pencil clip grip your pocket, can be avoided by wrapping a rubber band around the pencil and rolling it back under the ball of the clip. In this position, it will provide the necessary contact and friction to hold the assembly in place.

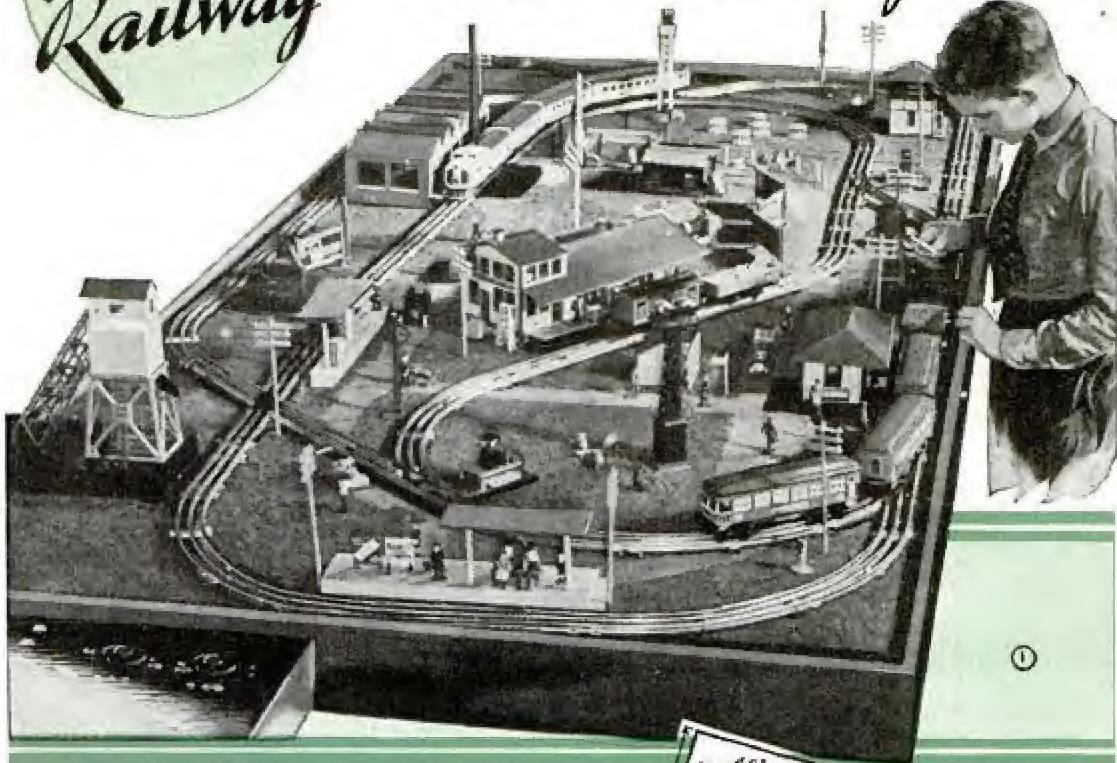
Repairing Leak in Garden Hose

You can patch a leak in a garden hose with a cold patch of the type used on inner tubes if you have a clamp like the one shown to put pressure on the patch while the cement is setting. If the hose has a corrugated or ribbed surface, it will have to be smoothed down.



Model Railway

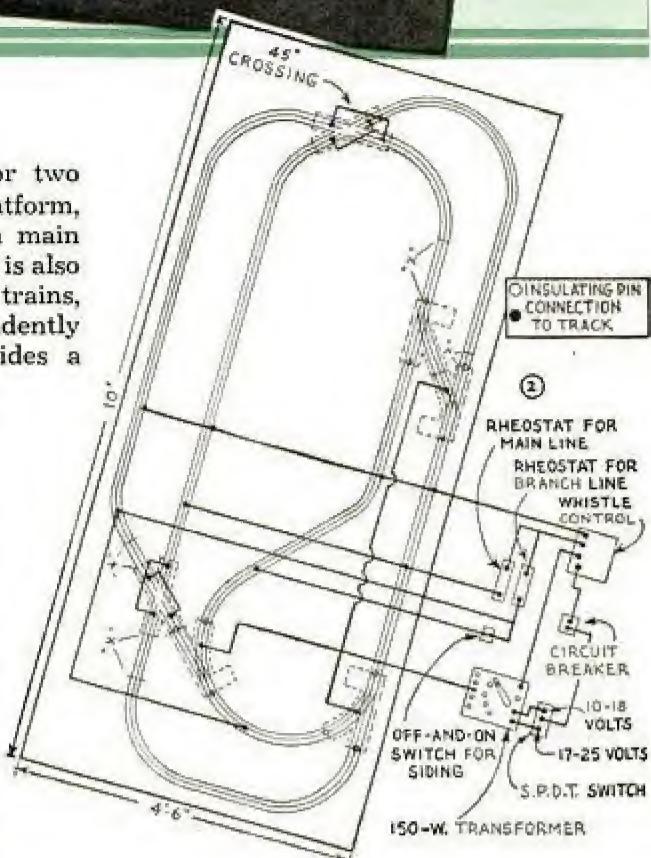
TRACK LAYOUT takes small space

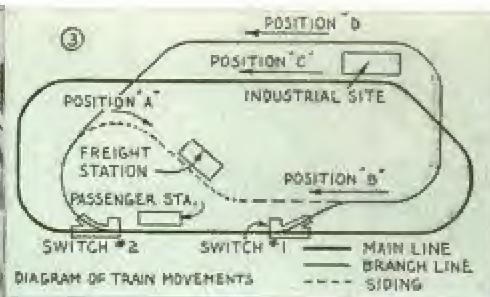
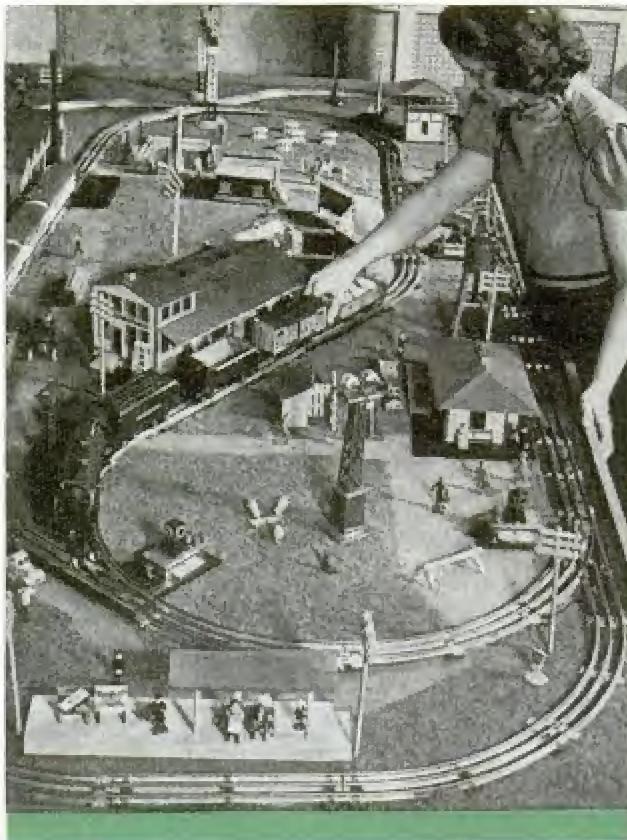


By Elmer C. Black

DESIGNED for operating one or two trains on a moderate sized platform, this complete layout, Fig. 1, has a main line, branch line, and a siding, which is also used to reverse the direction of the trains, those on each line being independently controlled. Also, the layout provides a "scenic route," permitting a train to cover the entire track system by operating but one switch.

Use a base of nonwarping material, such as hard-pressed board, and lay the track as in Fig. 2, cutting short lengths of straight track to fit at the points marked "X." Place insulating pins in the center rails where indicated to separate the circuits, and wire the layout as shown. Insulating pins in the outside rails of the nonderailing type switches should be placed according to the manufacturer's instructions. On the underside of the





crossings, a piece of tire tape is placed between the two metal connector strips to separate the circuits at these points. After wiring, if the proper current does not reach the track, reverse the two wires leading from the whistle controller. Remote-control equipment with nonderailing switches will prove most satisfactory, and the operating controls are brought to a central panel for efficient control of the trains.

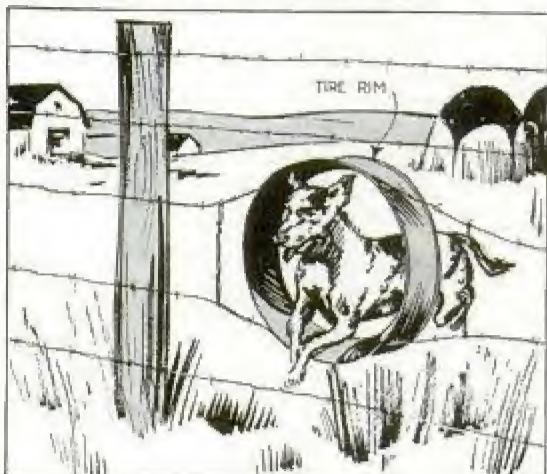
A s.p.d.t. toggle switch steps up the voltage when running two trains at once, and an off-and-on toggle switch in the circuit to the siding controls trains on this section. Separate rheostats regulate the train speeds on either line. If desired, lead weights may be placed in a car of the faster train to balance the speeds to keep the trains the same distance apart on the short section between switch No. 2 and switch No. 1, Fig. 3, where both trains use the same track. Use at least a 150-watt transformer for the power source. To protect the whistle controller, do not blow the whistle when both trains are running.

Many interesting train movements can be executed on this layout. For a "scenic route," start a train from position "A," Fig. 3, running it in the direction of the arrow.

With switch No. 1 closed, the train will circle around the entire layout without attention. To reverse direction of a train, open switch No. 1 and run train from position "B" over siding and back to the original position. For continuous running of two trains at one time, bring a train to position "C" and "D" respectively. Start the train at position "D" on the branch line, and when it passes the crossing start train at "C." By alternately opening and closing switch No. 1, each train can be kept to its own line or shifted to the other as desired. Use the rheostats on each line to control train speeds to avoid smash-ups at the crossings. Suggested locations for a freight and passenger station and an industrial site are indicated in the diagram.

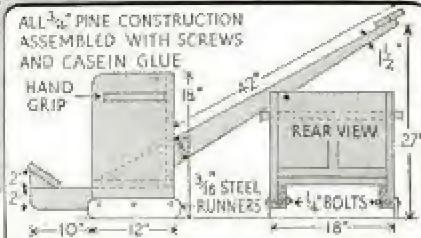
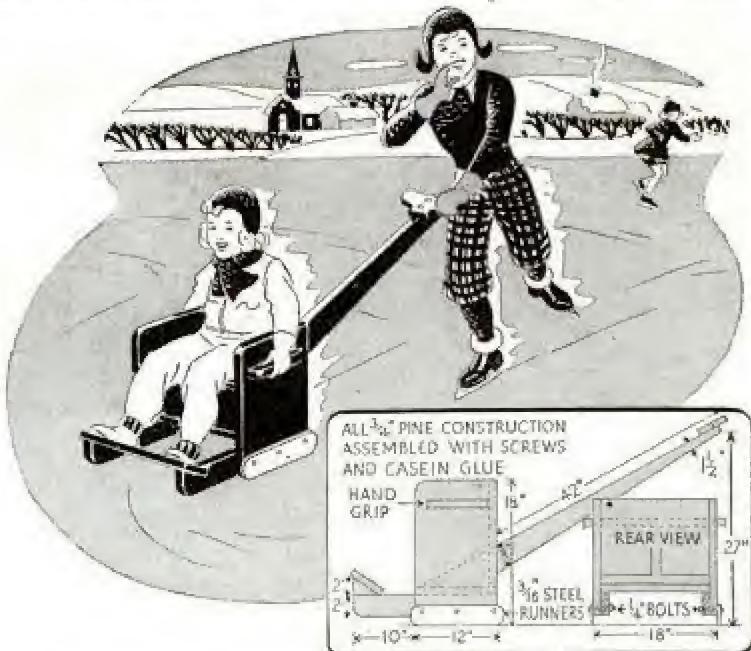
Auto-Wheel Rim in Wire Fence Makes Safe Gate for Dog

After his dog had become injured from jumping through a barb-wire fence, one farmer provided a gate through which a dog could pass in safety. The gate was made by wedging an auto-wheel rim between the fence wires as indicated.



Ice "Ricksha" Gives Little Tots Thrilling Ride

A young member of the family who is too small to skate can enjoy the ice with this sled, which is pushed and guided easily by someone on skates. The sled is of the simplest construction, and is fitted with a substantial foot-rest and hand grips for safety of the passenger. A strong push bar and short, steel runners make it possible to handle the sled in quite intricate maneuvers on the ice, especially if the bar is lowered a little to bring the runners up on the rear ends. Paint the sled in contrasting bright colors.



Emergency Chick Hover From Lamp and Laundry Tub

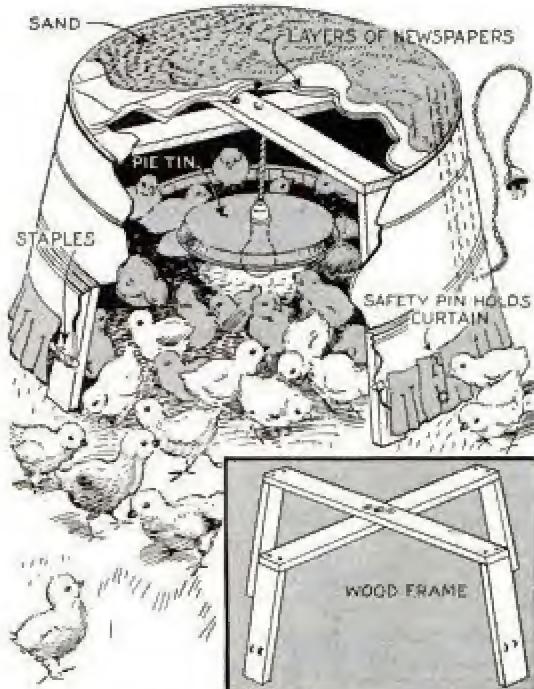
Inverted over a wood frame, a galvanized-iron laundry tub makes a temporary chick hover. Heat is furnished by an electric bulb suspended from the frame on an extension cord, using an old pie tin as a reflector. After cutting a piece of cloth and fastening it around the lower end of the tub to serve as a heat-retaining skirt, the

hover is ready for use. Efficiency is increased by placing several thicknesses of newspaper on top of the tub and covering it with sand.

—E. G. Machauer, Memphis, Tenn.

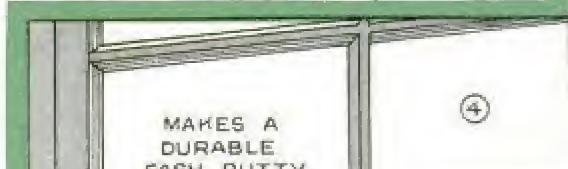
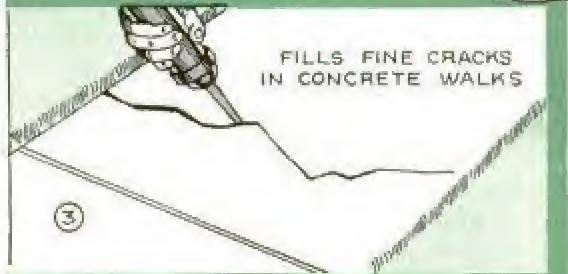
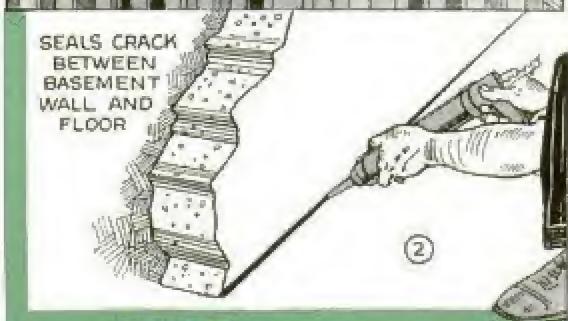
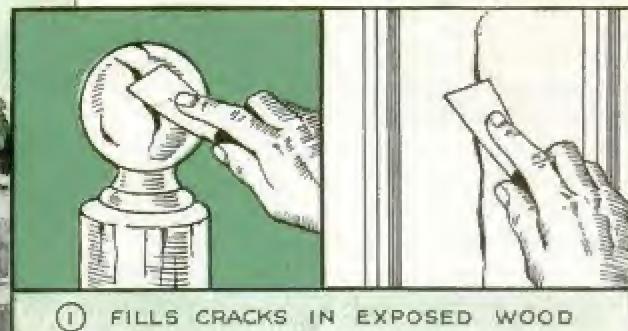
Placing Rivets in Metal Tubing Done Easily With Thimble

When large sheet-metal tubing must be riveted on a mandrel, difficulty of holding rivets to insert them into the holes of the tubing can be avoided by using an ordinary sewing thimble with a keyhole slot in it. The large part of the slot should be of a size to take the rivet head, which then may be pushed back to bring the shaft of the rivet into the slot. In this position, the rivet is held securely against the finger tip so that its placement is simplified. After the rivet has been inserted, the upper end is gripped with the fingers and the thimble removed.





What you can do

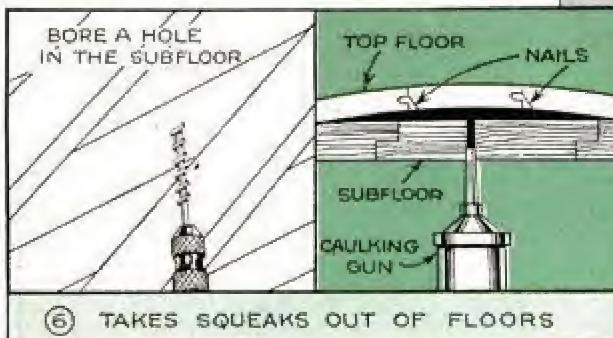


IN BOTH the knife and gun grades, caulking compound has a number of practical uses. Fig. 1 shows how you can use the knife grade as a crack filler on wood exposed to the weather. Ball tops of ornamental fence posts and the board-and-batten siding on outbuildings are good examples. The wood should be painted first and care should be taken to see that there is no water in the cracks before filling. After the compound has dried, you can apply the finish coat of paint and get a smooth job.

Narrow cracks between the basement wall and floor, and fine cracks in concrete walks can be filled with gun-grade compound to seal against seepage of water and to prevent frost breaking up the walks. In the first method it should be noted that this procedure is not a substitute for the recommended joint made by inserting an asphalt-coated expansion strip between the wall and the floor. However, caulking compound serves the purpose in an emergency. Always be sure the surfaces are dry before forcing the material into the cracks, as in Figs. 2 and 3. The knife-grade compound makes a durable and easily-applied sash putty, Fig. 4, particularly on old sash. All loose putty should be removed and the surfaces primed before you apply the compound as a putty. Fre-

Dear, Robert C. Cheago

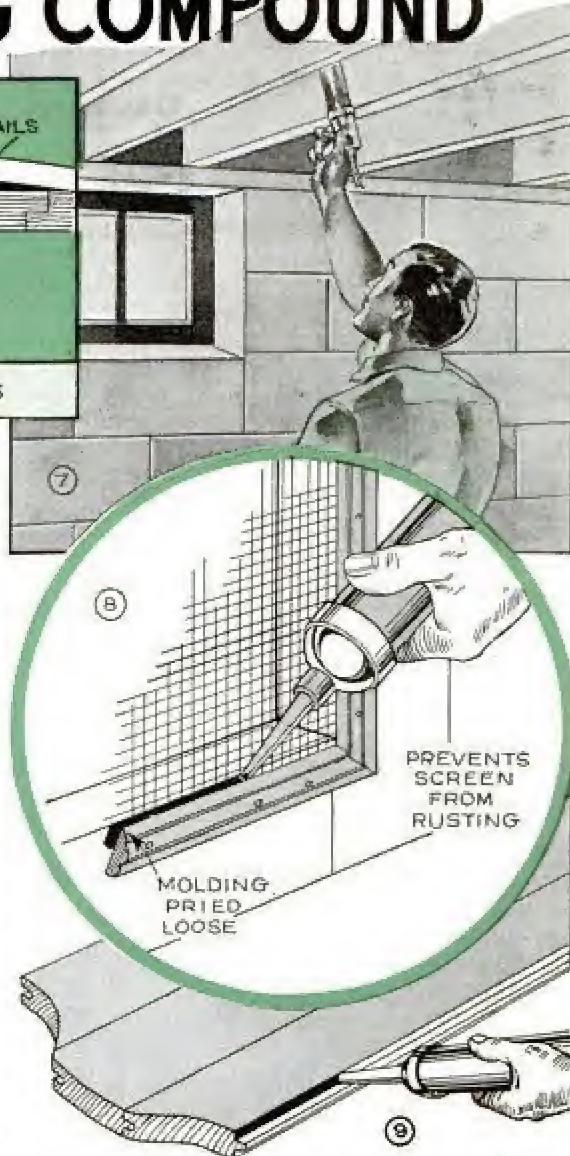
with CAULKING COMPOUND



quently you can make use of the gun-grade compound for sealing the openings between warped siding boards, Fig. 5. Forcing the compound into the opening and then re-nailing makes a tight job.

Squeaky floors can nearly always be silenced by the simple procedure shown in Figs. 6 and 7. At the point where the squeaks occur, the flooring will generally be slightly loose and perhaps bulged upward. After locating this point, bore a hole through the subfloor to take the nozzle of the caulking gun. Force the material through this hole and under the top floor as in Fig. 7. Plug the hole in the subfloor. Then re-nail the flooring from the top side, sinking and putting over the nail heads. Next time you paint your screens, loosen the molding across the center and lower rails and lay a thin line of the compound in the opening as in Fig. 8. Then re-nail the molding. This will prevent water running under the molding.

Farmers who build floors of tongue-and-groove stock for wagon boxes, grain racks and brooder houses find that laying a thin line of compound on top of the tongue of each board as in Fig. 9, not only helps prevent warping but preserves the floor and keeps it tight. Made thus and well painted or creosoted, the floor is very nearly waterproof. Still another practical use for the knife-grade compound is shown in Fig. 10. Where wide siding is not mitered at the corners but is joined by alternately overlapping the ends, the end grain becomes rough with weathering, making it difficult to get a smooth paint job. A thin film of the knife-grade compound applied after the primer is dry, levels the roughened end grain and when dry the paint will go on smoothly.



WATERPROOF JOINTS IN TONGUE-
AND-GROOVE FLOORING

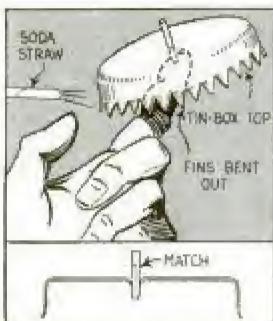


Hose Stop on Miter-Gauge Stick Easily Lifted for Longer Cuts



When sawing wood strips to predetermined lengths it is sometimes necessary to square a few of the strips at both ends. If a permanent stop is fastened to the miter-gauge stick, a block must be placed back of the gauge so that it will slide past the stop to feed squarely against the saw. To avoid this, use a piece of heavy radiator hose for a stop. Then, when changing ends of the work to square one of them, it is only necessary to lift one side of the hose stop to allow the work to pass.

Simple Tin-Box Top Spins On Your Finger Tip



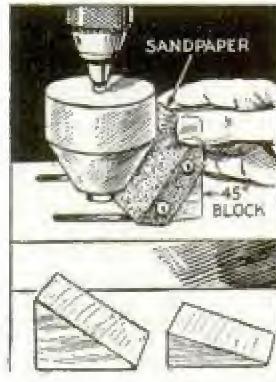
This is pointed on the lower end, which projects just through the cap. If you wish

An amusing top, one which may be spun on the tip of your finger, and even operated by blowing through a soda straw against it, can be made by punching a hole through the center of a box top to take a match stick.

to make the top so that it may be driven by an air current, serrate the edge, making the serrations about $\frac{1}{4}$ in. apart, bending them outward as shown. This provides fins or blades to catch the air.

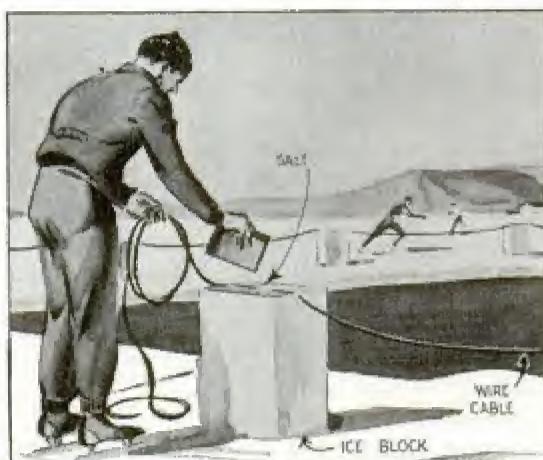
Angle Blocks Hold Sandpaper Against Work in Drill Press

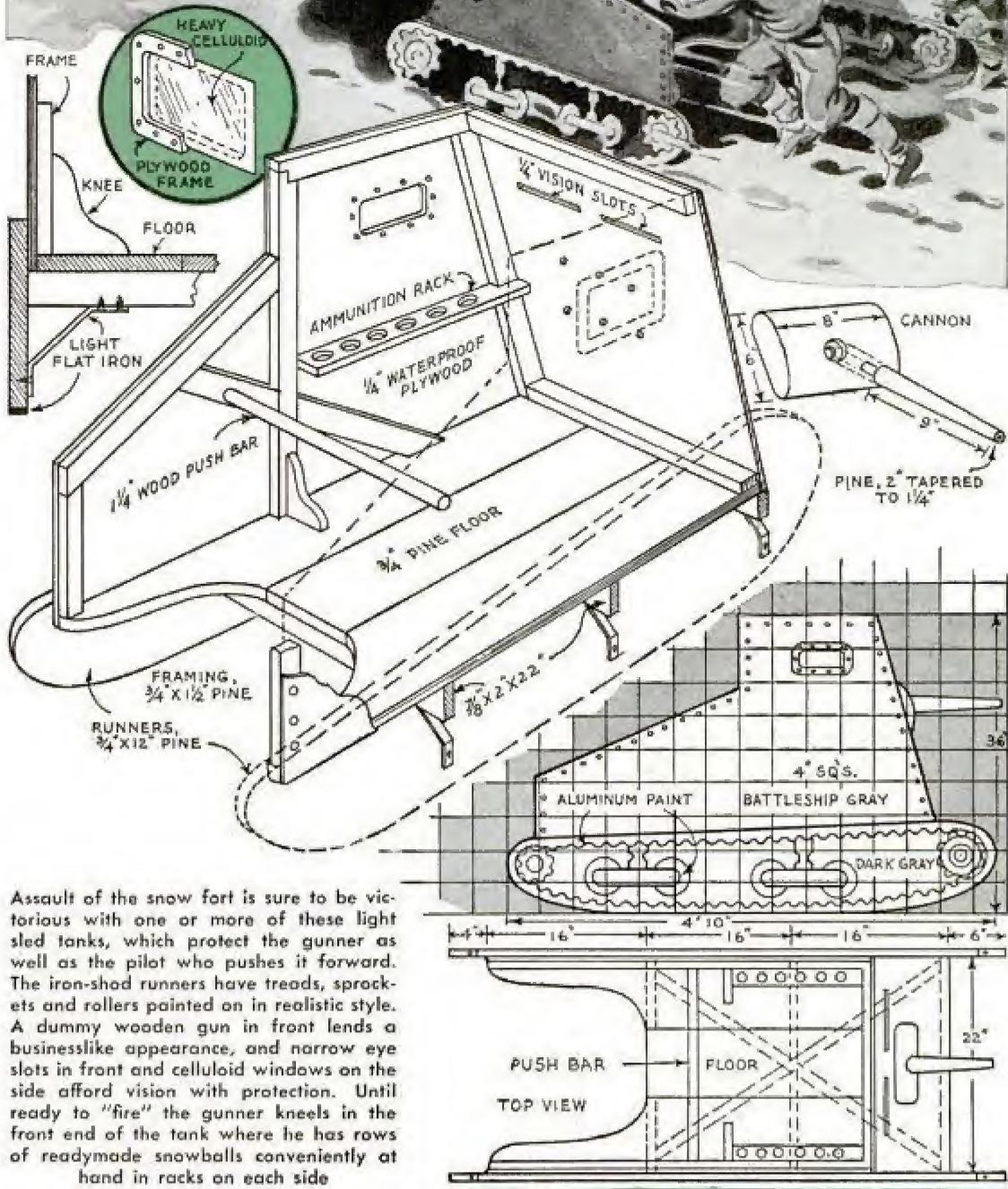
Rapid and accurate sanding of wood or metal parts can be done on a drill press with the aid of angular blocks to hold the abrasive paper. Three of the blocks with surface angles of 90, 60 and 30 degrees will allow a great number of angular settings when used singularly or in combination. Parts to be sanded are clamped in a drill chuck, or if they are too large for this they can be clamped to a threaded mandrel. Thumb tacks are used to fasten the abrasive to the working surface of the blocks.



Salt Freezes Cable to Ice Blocks To Make Safety Fence

If a fence or barrier is required around a large air hole in the ice to prevent skaters from accidentally running into it, you can use blocks of ice and a rope or cable to make a good fence. After stringing the cable across the top of the ice blocks, pour a little salt on top of each one which will cause the cable to freeze to the blocks.





Assault of the snow fort is sure to be victorious with one or more of these light sled tanks, which protect the gunner as well as the pilot who pushes it forward. The iron-shod runners have treads, sprockets and rollers painted on in realistic style. A dummy wooden gun in front lends a businesslike appearance, and narrow eye slots in front and celluloid windows on the side afford vision with protection. Until ready to "fire" the gunner kneels in the front end of the tank where he has rows of readymade snowballs conveniently at hand in racks on each side.

Oil Prevents Soil From Sticking On Post-Hole Digger



When digging post holes in heavy clay or gumbo soil, much time and work wasted in knocking the soil from the tool can be saved if the blades of the digger are dipped in a bucket of waste oil at regular intervals. The oil film on the digger prevents sticking and makes the soil slip off easily when the digger is lifted from the hole.

Wire Lifter in Wastebasket Loosens Packed Paper

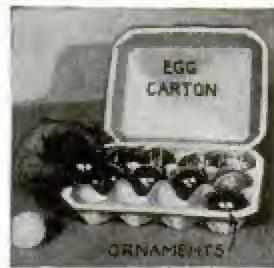
The annoyance of digging packed paper from the bottom of many wastebaskets, and the possibility of injuring his fingers on pieces of tin or broken glass carelessly



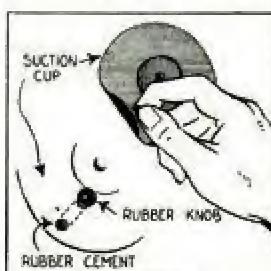
tossed into them, caused one janitor to make lifts of wire with which to loosen the paper. When emptying the baskets a pull on the wire lift does the trick, making it unnecessary to put the hands inside.

Ornaments for Christmas Tree Stored in Egg Cartons

Pulpboard egg cartons provide handy containers in which to store fragile glass ornaments used on your Christmas tree. The cartons are suitable only for storing the smaller sizes of ornaments which will fit in the openings, and each one will hold twelve.



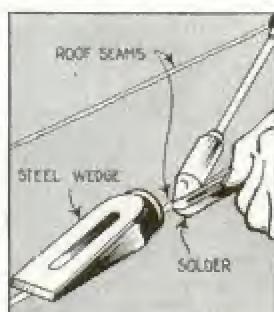
Knob on Large Vacuum Cup To Release It Instantly

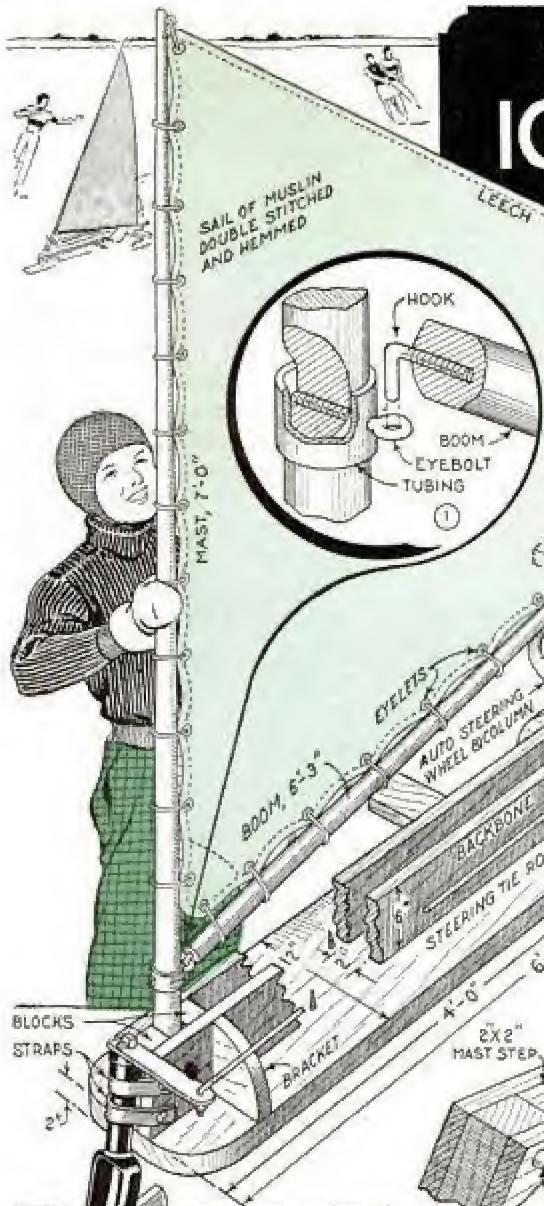


Large vacuum cups of the type often used on car-top luggage carriers are sometimes difficult to release unless you have some means of lifting one edge of the cup to break the vacuum. A good way to do this is to cement a rubber knob to the edge to serve as a finger grip for lifting the cup.

Steel Wedge Keeps Roof Seams From Breaking or Buckling

In order to solder the seams of a metal roof rapidly without having them buckle and open before the solder has cooled thoroughly, a tinsmith uses a heavy steel wedge. This is moved along the seam as the soldering progresses, holding the metal surfaces together. It also dissipates the heat so the solder cools more rapidly.

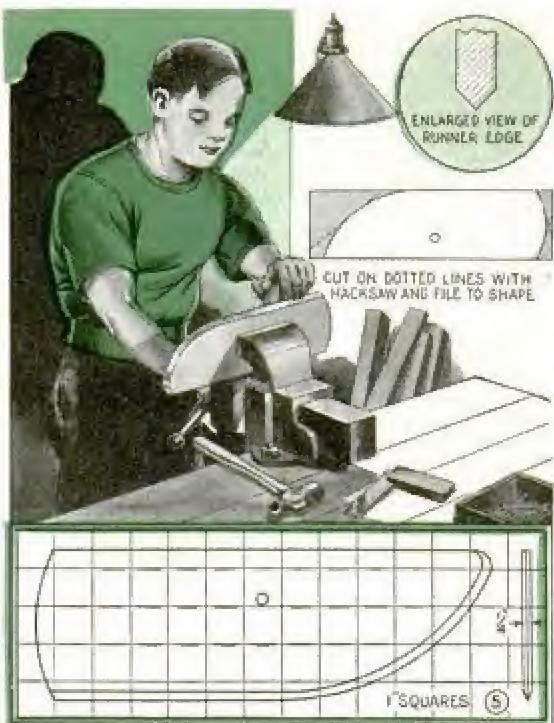




Junior's ICE SCOOTER

gives thrilling ride

SIMPLE construction and low cost enable any boy to have one of these ice scooters. First get a 2 by 12-in. plank, 6 ft. long, round the front end, and attach a backbone, which consists of two 2 by 6-in. planks, 4 ft. long. These are set on edge on the body and are securely fastened to the latter by driving long lag screws through both from the underside of the body. To simplify driving the screws and to prevent splitting the wood, you first drill holes through the body to permit the screws to barely slip through, and then you drill pilot holes in the backbone pieces. Soap the threads of the screws, slip a washer on them against the head, and drive them in. Brackets on each side of the backbone are also advised, these being attached to the backbone pieces before they are fastened down on the body. You will note that there are three blocks set in between the backbone pieces. The forward two are spaced to provide a mast



step and the aft one helps to support the steering column. The blocks are fastened in place by means of carriage bolts as shown in Fig. 2.

The front runner support is an old bicycle fork, which is cut off, flattened and drilled to suit as shown in Fig. 4. The fork is clamped to the front end of the backbone with heavy flat-iron straps, these being welded to the fork, or bolted to it with short machine screws so they will not interfere with the inside piece that turns. The steering post is similarly attached with flat-iron straps. It consists of a length of

pipe which serves as a bearing for a steel rod. A short arm about 6 or 8 in. long is attached to the steering fork, and one of similar length is pinned and clamped to the steering column, both extending out toward one side and linked together with a $\frac{1}{4}$ or $\frac{3}{8}$ -in. iron connecting rod. This is threaded at both ends, after which the ends are bent over at right angles to fit holes in the arms. Be sure that the pivot points work freely. Two nuts on each end, locking each other, are better than only one nut, which is likely to come off.

Runners are all the same size. They are cut out of $\frac{1}{4}$ -in. boiler plate by means of a hacksaw, and the lower edges are filed to a sharp edge as shown in Fig. 5. One of the runners is attached to the front fork by means of a steel rod, threaded at both ends for nuts, and a couple of spacers that center the runner between the ends of the fork. The spacers may be cut from pipe. The rear runners are pivoted between two lengths of angle iron bolted to the ends of the rear crosspiece, which is a 2 by 6-in. plank, 4 ft. long.

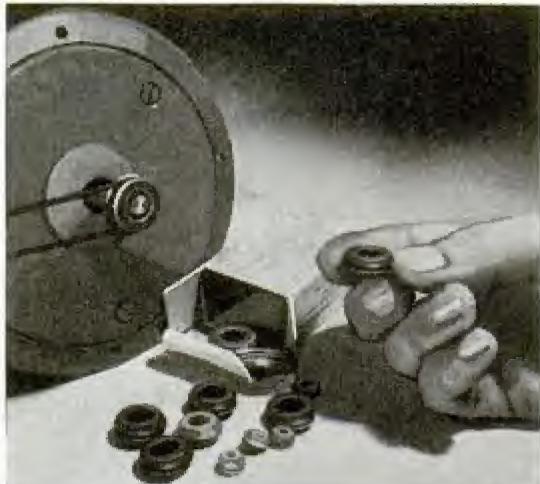
For a sail you can use muslin, double stitched and hemmed. The corners should be reinforced for strength. Eyelets (grommets) are inserted along the mast and boom edges of the sail for light rope lacing. The boom should extend upward at an angle sufficient to clear the rider's head as well as the steering wheel. Fig. 1 shows how a hook on the bottom fits an eyebolt through the mast. However, an eye welded to a ring that can be clamped to the mast is preferable because any hole through the mast tends to weaken it.

Rubber Grommets Used as

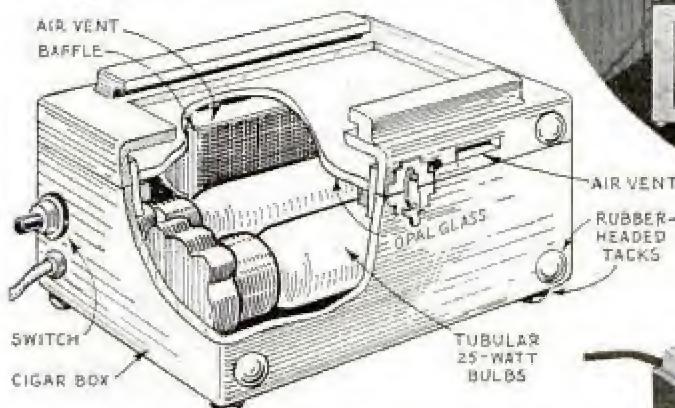
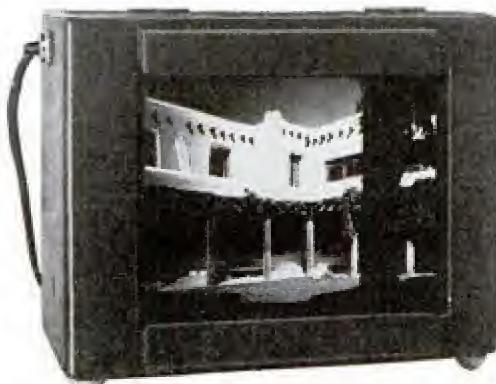
When a small pulley is required for running a toy or model by means of a string belt, and there is none at hand, a rubber grommet will serve the purpose. These are usually available at radio repair shops. They can be obtained in different sizes and will stretch to fit small shafts of various diameters. Made of live rubber, the grommets will grip a shaft securely without the use of a key or cement, and the string or cord used as a belt will have no tendency to slip.—Kenneth Murray, Colon, Mich.

To make sandpaper stick to a disk sander, apply ordinary linoleum cement. This dries very quickly to form the necessary bond.

Small Belt Pulleys on Toys



Viewing Box for Color-Film Transparencies



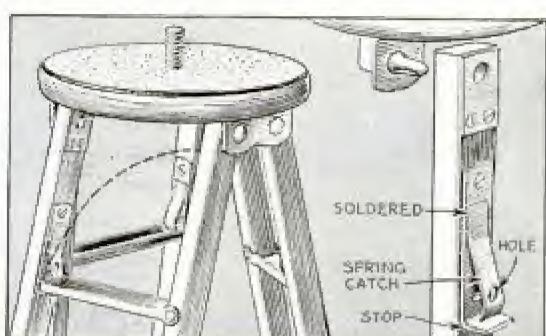
Besides making the examining of color-film transparencies a simple matter, this compact viewing box, when fitted with a long extension cord, can be passed among your guests without them moving from their seats. It's made from a cigar box, which is fitted with two sockets and tubular lamps, the latter being wired through a radio panel switch located conveniently in one end of the box. A sheet of opal glass, not ground glass, diffuses the light and is supported on cleats just under the box cover, thus dividing the assembly into two parts. An opening of the proper size to ac-



commodate the transparencies to be used is cut in the cover, and rabbeted strips are glued at opposite sides of the opening to provide slides for holding the film. Vent openings in both the cover and box are fitted with baffles to prevent escape of light.

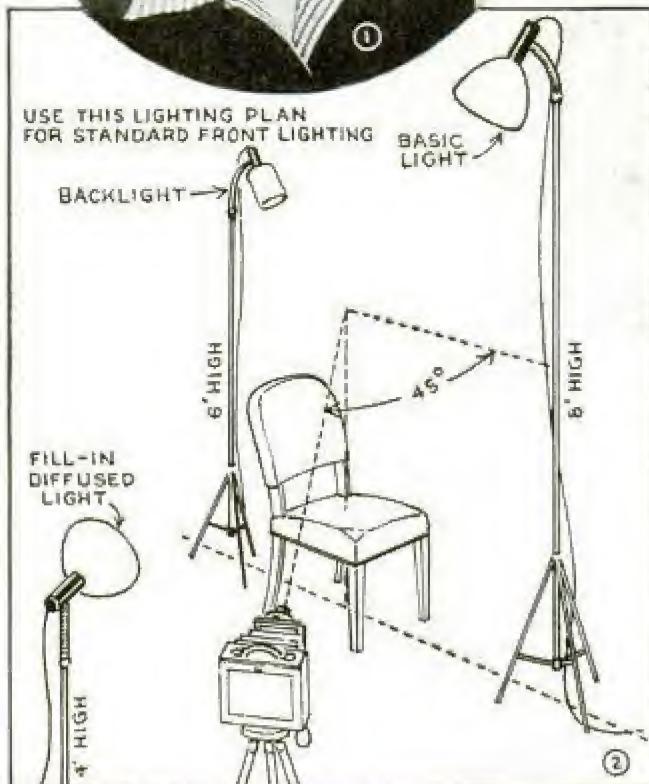
Metal Safety Catch Holds Legs Firmly on Tripod Head

Tripod legs of the type shown in the drawing will not come loose from the head accidentally if they are fitted with these safety catches. Each catch is a strip of spring bronze, bent as indicated and soldered to the brass stop piece against which the spreader on the leg rests when the tripod is set up for use. The hole near the lower end of the catch is to provide access to the screw that holds the stop piece on the leg of the tripod.



GOOD PORTRAITS

By Thomas P. Lake



POSITION of lights is the most important factor in making good portraits, and this is where most amateur photographers go wrong when they begin portrait making. The professional photographer can, and usually does, retouch his negatives to obtain effects. As retouching requires a high degree of skill, the amateur usually must print or enlarge his negatives without alteration. For this reason the amateur must be exceedingly careful to obtain the best possible results in his first negatives.

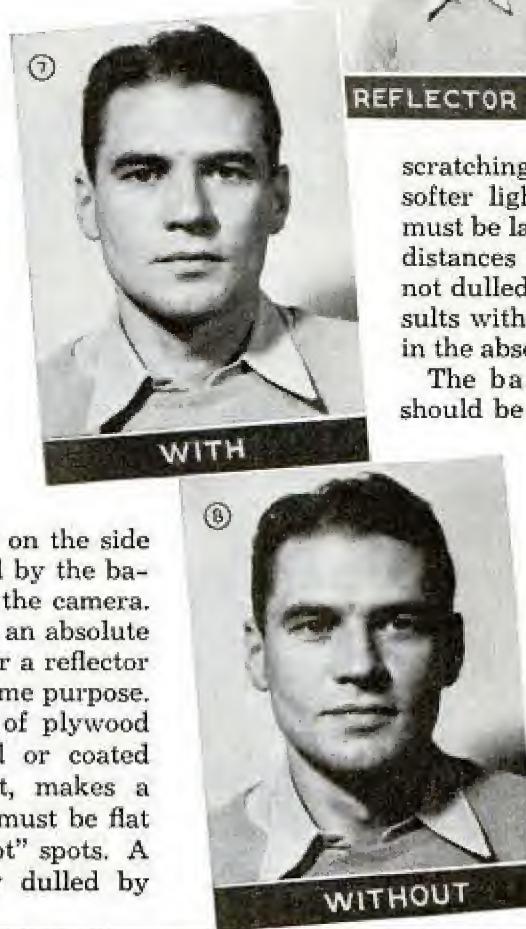
Fig. 1 shows a normally well-lighted portrait such as any amateur might want to make. It is made with standard front-lighting as in Fig. 2, which is typical of the effects which must be looked for in almost any lighting plan. The main or basic light takes the place of the sun, for it creates the strongest or key shadows. The fill-in light takes the place of the light from the blue sky or a sunlit white wall, and prevents the shadows from being pure black. The backlight is a device which has no equal in nature, but serves to give sparkling highlights on the hair. The separate effects of each of

these three lights are shown in Figs. 3, 4, and 5. These effects are all combined to produce Fig. 1. Fig. 10 illustrates the effect which occurs when the fill-in light is missing, while Fig. 11 shows what happens if the backlight is omitted.

However, it is possible to make portraits with fewer lights, particularly where pictures must have strong contrasts to stand reproduction in newspapers, but these are outside the field of the amateur who makes his portraits to be looked at and wants completely recognizable likenesses. The fill-in light, which is weaker than the basic light, is usually placed near the camera so that its light will fall equally on all surfaces visible to the camera. In practice it is usually convenient to place it on the side opposite that occupied by the basic light, and close to the camera. The fill-in light is not an absolute necessity, however, for a reflector can be used for the same purpose. See Fig. 6. A sheet of plywood covered with tin foil or coated with aluminum paint, makes a good reflector, but it must be flat to avoid bright or "hot" spots. A foil surface slightly dulled by



REFLECTOR USED AS FILL-IN



scratching with steel wool gives a softer light, but such a reflector must be larger or be used at closer distances than a reflector that is not dulled. Figs. 7 and 8 show results with and without a reflector in the absence of a fill-in light.

The basic light, (see Fig. 2), should be placed so that the nose

casts a very short shadow either below or slightly diagonally. This shadow should not reach the line of the upper lip. After establishing the position for the basic light, which usually produces the best effect when about 7 or 8 ft. high, the camera may be adjusted up or down according to the de-

BE SURE TO AVOID THESE COMMON ERRORS



NOSE CROSSES CHEEK LINE



FILL-IN MISSING



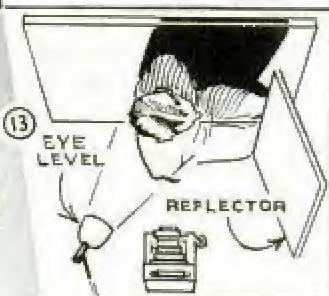
BACKLIGHT MISSING

DARK OUTLINE



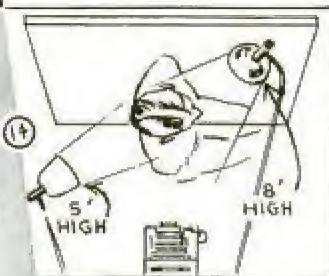
Here profile line is in partial shadow against washed-out background

SHADOW CONTRAST



Background left in some shadow from head; reflector used to light face

HIGHLIGHTED



Profile and part of cheek lighted with basic light placed on side of subject

PROFILE LIGHTING

mands of the subject. A short, turned-up nose requires that the camera be placed somewhat above the nose, often 4 or 6 in. above the top of the head. A Roman or hooked nose should be photographed from a low camera position, usually about shoulder height. Deepset eyes are likely to be concealed in shadow if the basic light is too high and for these a lower position must be used. If lowering the light makes the nose shadow too short, the shadow can be lengthened again by moving the light to either side and making the shadow somewhat diagonal.

Either the fill-in or the basic light should be adjusted so that a bright spot—called a "catchlight"—appears on the eyeballs. Normally, only one catchlight should appear, although two may be allowed if one is less conspicuous. Without catchlights, the eyes lose sparkle and life. In these halftone reproductions, however, catchlights on the eyes are evident in only a few cases, having been lost by considerable reduction in size. Sometimes a small white reflector can be held so as to produce the catchlight when it is not desirable to alter the position of the lights.

Avoid poses like that shown in Fig. 9, where the nose just crosses the cheek line. When both eyes are shown, the inside portion of the far eye should be visible, or an unnatural appearance results. Fig. 9 could be turned into a profile shot by turning the head farther from the camera, or into a front angle view by turning the head somewhat toward the camera. Portrait photographers sometimes state this rule by saying "show the white of both eyes."

The lips photograph best if they are wetted just before the exposure is made. Remind the subject to "lick your lips" and then make the exposure before the pose becomes strained. Wet lips show interesting highlights; but if they are dry, they tend to lose their roundness and life. Wrinkles or creases in the face can be "washed out" by filling them with a flat light, while they can be made very prominent by a strong "contour" lighting — one which makes a small angle with the surface, like the late afternoon sun which casts long shadows over a landscape. Portrait backgrounds should be plain and inconspicuous. Light walls can be used for brunettes, while blondes are best photographed in front of a dark background.

Among interesting portraits which can be taken easily with only one or two lights are profiles. In Fig. 12, the basic light was placed slightly behind the subject and

45-DEGREE LIGHTING



thereby makes the actual profile a line of partial shadow. The shadow of the subject on the background was washed out by a background light. Fig. 13 was made with similar lighting, except that the background shadow was not washed out, and the subject's profile was given a soft illumination from a reflector carefully placed to avoid lighting the background. In Fig. 14, the basic light was placed on the side of the subject away from the camera, and was adjusted so that it lighted the profile and part of the near cheek. These three profile effects are easy to secure by duplicating the lighting plans shown.

Another popular type of portrait is that made with 45-degree lighting. This lighting is similar to front-lighting, but the basic light is shifted so that the nose shadow runs diagonally down the "laugh" line and merges with the shadow on the lower portion of the cheek. This arrangement leaves a triangular patch of light on the upper portion of the cheek, as shown in Figs. 15 to 17 inclusive. After the basic light is properly located, the fill-in light is turned on and brought in on the opposite side, near the camera, so that the shadows will not be too black. The backlight, or toplight as it is called when used in this way, is located to give life to the hair. This portrait lighting is especially effective with men, for its bold shadows give the impression of vigor and strength, but not always appropriate for women as the strong contrasts detract from the usual desired effect of daintiness.

Lights used in home portraiture can be of any simple type, either with the inex-

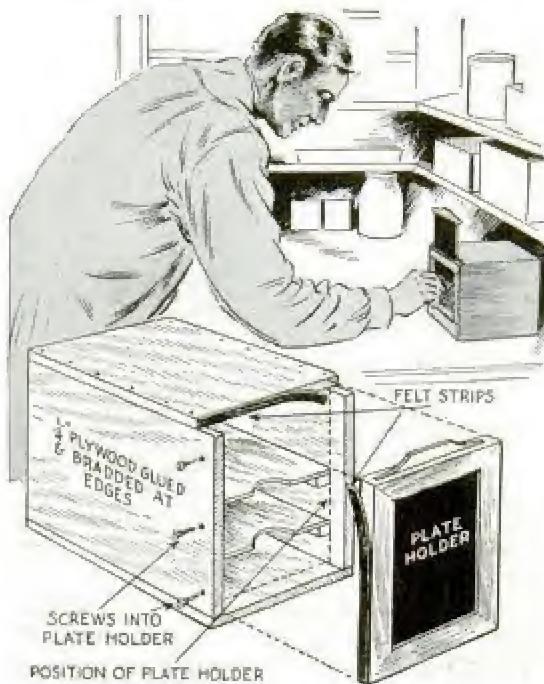
pensive adjustable stands or with homemade ones. A No. 2 floodbulb should be used for the basic light, while No. 1's will do for the backlight and fill-in light. The fill-in light is usually best when a yard-square piece of white silk is held in front of it with a wire frame, so that any shadows it makes are soft edged and inconspicuous. The backlight or toplight should be shielded by a metal tube—a can with top and bottom cut out will do nicely—so that its light will not shine into the camera lens. An oversize lens hood should always be used; this may be made from a piece of black paper and be just as satisfactory as commercial types.

Paper Staples Hold Snapshots In Photograph Album

Try using an office paper stapler to fasten your snapshots in an album. Drive the staples so they straddle the corners of the prints and the pictures can be slipped out of the album and replaced easily.



Old Plate Holder Used as Door Of Paper Storage Cabinet



A lightproof cabinet for photographic paper can be made from an old plate holder and a few pieces of $\frac{1}{4}$ -in. plywood. The size of the box will depend upon the size

of plate holder available. Paint the inside flat black and put in two or more shelves. Before using it for paper, check the box carefully for light leaks.

Small Spring Tightens Film Pack In Worn Adapter of Camera

Film-pack adapters which after considerable use allow the pack to rattle around inside, possibly causing light leaks, need not be discarded. This trouble can be corrected easily by using the small flat spring which holds films flat in a film pack. As the spring is very light sheet metal, it can be cut from a discarded pack container with a pair of scissors. Place the spring on the back of a new pack before closing the cover of the adapter and it will provide enough pressure to keep the pack in place.

—D. W. Holen, Minneapolis, Minn.



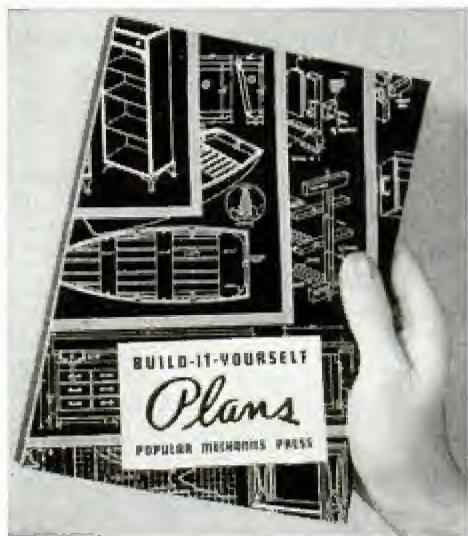
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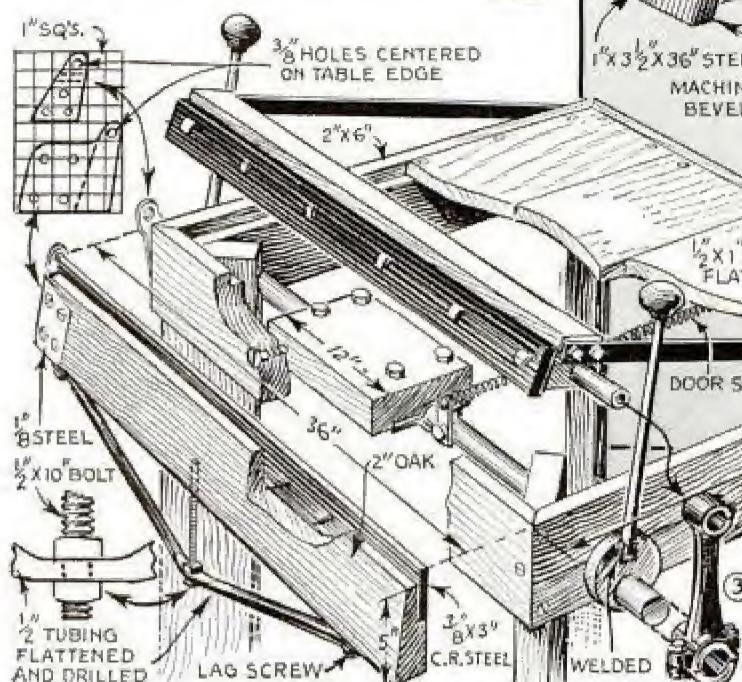
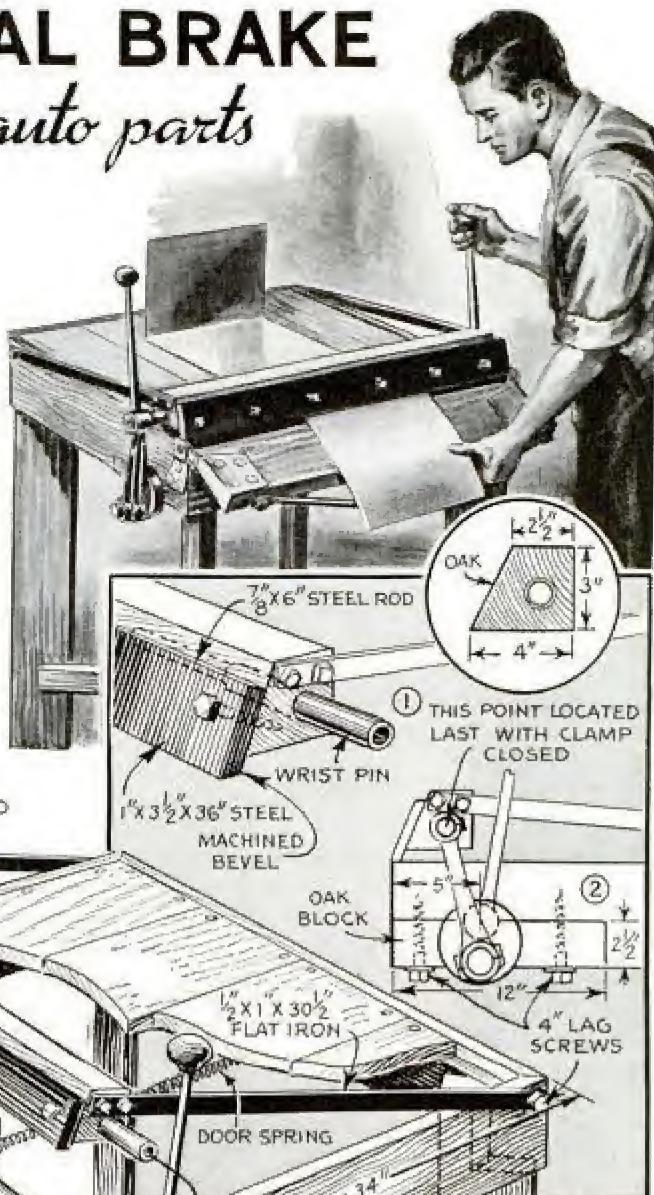


SHOP NOTES

SHEET-METAL BRAKE *from old auto parts*

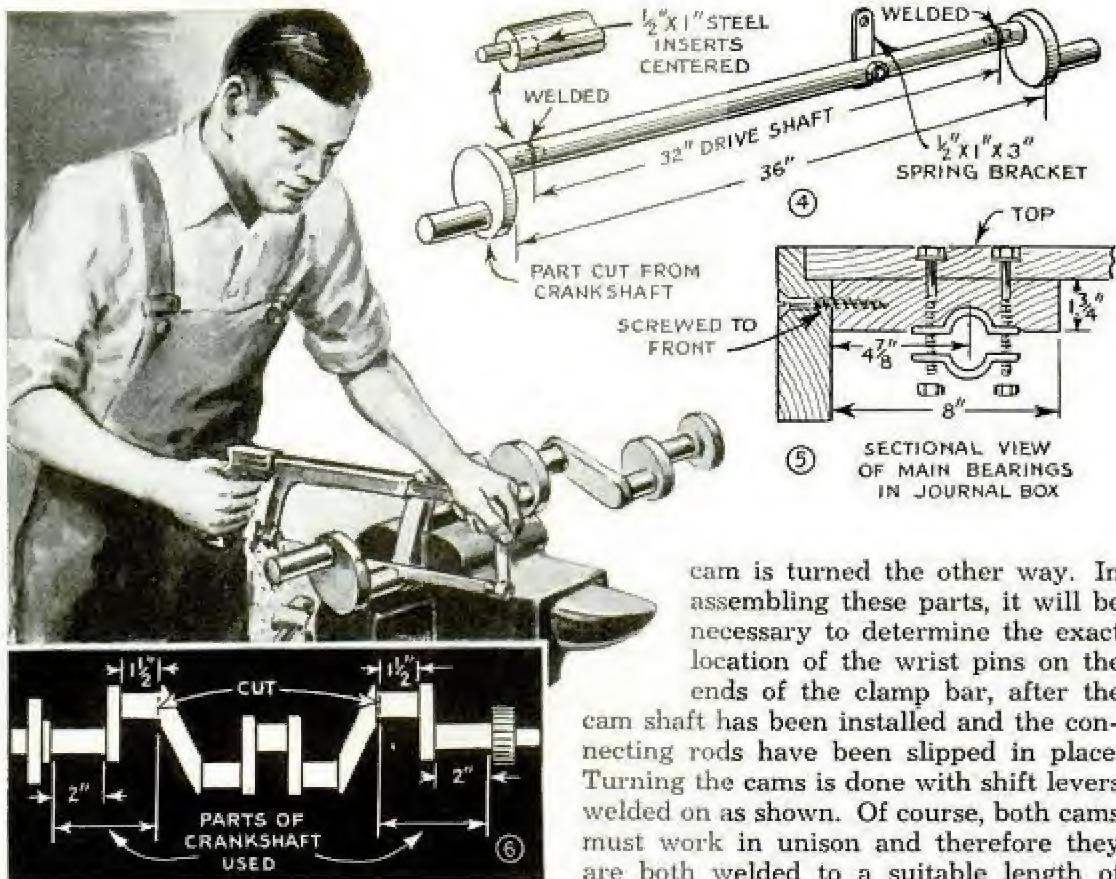
By W. Keith Vining

SHARP, even bends at the corners of sheet metal up to No. 20 gauge in thickness are assured with this heavy-duty brake, which any craftsman in metal work can build. Most of the parts required for the mechanism are old auto parts that can be obtained in an auto-wrecking yard. In making up the original model, Ford Model-A parts were used, and the dimensions given in the drawings were based on these parts. However, parts of other cars of approximately the same size can be



Here are the auto parts needed

- 1 Ford model-A crankshaft
- 2 Ford model-A connecting-rods
- 2 Connecting-rod wrist pins
- 2 Complete main bearings (four lower halves from Ford model A)
- 2 Gear-shift levers
- 1 1 1/2 x 32-in. drive shaft



used, but in that case the builder will have to allow for variations.

First build a sturdy table about 30 in. high, and having a top 34 by 36 in. in size as shown in Fig. 3. A clamp bar, which bears down on the sheet metal and holds it from moving while it is being bent by the bending jaw, is a 36-in. length of heavy steel as shown in Fig. 1. Its lower edge is machined at an angle so that it will rest flat on the edge of the table top as in Fig. 2. It is fastened with lag screws to a hardwood block dimensioned as in the insert above Fig. 1. The clamp has two $\frac{1}{2}$ by 1-in. flat-iron bars fastened to the ends, and these are pivoted to the sides of the table at the rear. A wrist pin with a 6-in. length of rod welded to one end, is forced into each end of the block as in Fig. 1. Each wrist pin fits a connecting rod, which in turn, pivots on the boss of a cam located directly below the clamp bar on each side of the table as in Fig. 3. The connecting rods should turn freely on the wrist pins and cam bosses. With this arrangement, the clamp bar will pinch the sheet metal firmly when the cam is turned one way, and similarly, the clamp bar will raise to clear the work when the

cam is turned the other way. In assembling these parts, it will be necessary to determine the exact location of the wrist pins on the ends of the clamp bar, after the cam shaft has been installed and the connecting rods have been slipped in place. Turning the cams is done with shift levers welded on as shown. Of course, both cams must work in unison and therefore they are both welded to a suitable length of drive shaft as in Fig. 4. The cams themselves are parts of an old crankshaft as shown in Fig. 6. Bearings to hold the cam shaft are located in a journal box under the table top at the center, the box being bolted to the table top and to the front apron as shown in Figs. 3 and 5. A heavy coil spring extending from the back apron of the table to a short iron arm welded or bolted to the cam shaft, helps to keep the clamp bar in the closed position.

The bending jaw is a piece of oak faced with a length of $\frac{3}{8}$ by 3-in. steel along its working edge. A handle of $\frac{1}{2}$ -in. steel tubing, flattened at the center and both ends, is attached as shown in Fig. 3. The handle is V-shaped and supported at the center by a 10-in. bolt from which the head is cut off so that it can be driven into the wood. A pair of hinge plates, detailed in the upper left detail of Fig. 3, are bolted to the sides of the table so that the pivot holes are in line with the edge of the front apron.

Blueprints can be waterproofed and given a sheen and better legibility by rubbing them with a cloth dampened with a solution of rosin, 50 grains, paraffin, 100 grains, and turpentine, 1 oz.

Bench Vise Converted Into Small Arbor Press

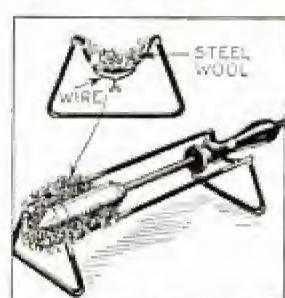


For the cost of a small steel plate and a short length of heavy angle iron, you can convert your bench vise into an arbor press for light work. First, reinforce the angle iron, which serves as the anvil of the press, with a couple of braces welded in place. Then screw a couple of guide bars to the underside. Next screw two similar bars to the steel plate in the positions indicated. These are drilled and tapped for screws passing through the anvil to permit its adjustment. Now, the plate is screwed to

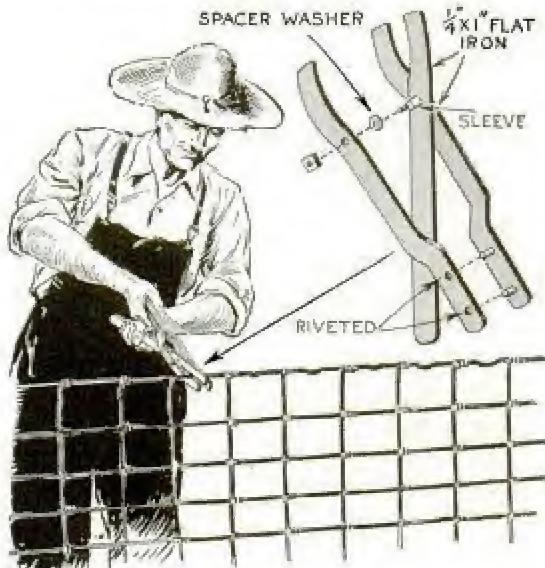
your bench top, and the vise mounted on top of it. Do this carefully so that the end of the vise beam aligns with a hole drilled in the face of the anvil when it is placed in position on the plate. This completes the job with the exception of drilling and tapping the end of the vise beam, which serves as the press screw, so that different plates can be attached. These can be made up in several forms with different points welded or screwed in the center to accommodate various types of work.

Steel Wool Pad Improves Electric Soldering Iron Stand

If you fasten a small wad of fine steel wool in one end of the trough of your soldering iron stand or holder, two useful purposes will be performed by it. Let the head of the iron contact the wool whenever it is resting on the holder, and the iron will have less tendency to overheat when not being used, as the added metal surface contacting it removes the excess heat and distributes it to the large area of the support. When you take up the iron again for use, rub the tip on the wool. This keeps it clean and eliminates the necessity of a separate cleaning brush or cloth which may be misplaced easily.



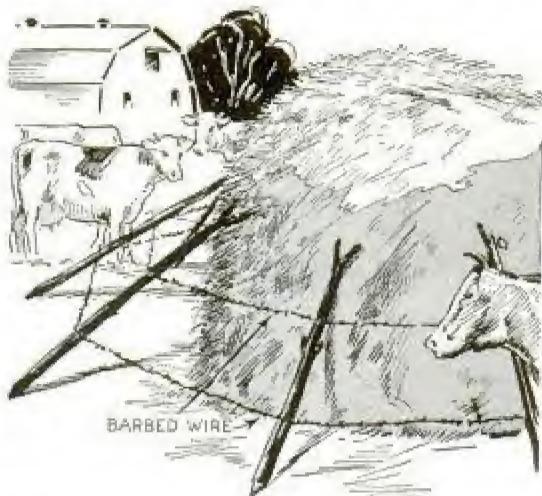
Wire Crimpers Tighten Fence To Make Temporary Repair



Woven-wire fencing that has begun to sag between the posts can be tightened quickly by re-crimping the horizontal wires with a tool of the type shown. Usually it is only necessary to crimp the top, bottom and center wires. Be sure to crimp all three as you go along as otherwise the fence will be stretched unevenly.

Simple Guard Prevents Cattle Getting at Haystack

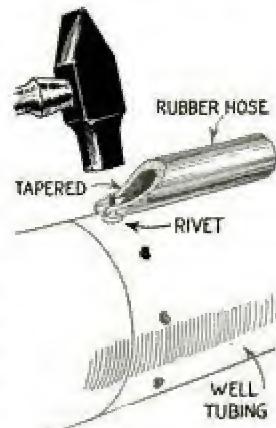
Instead of going to all the work of setting posts and stretching wire to fence a haystack temporarily, one farmer merely leans poles against the stack and nails the wire to them as indicated in the drawing. The poles must be long enough so that the ani-



mals will not be able to reach through the fence and get at the haystack.

Holder Keeps Rivets in Tubing While Adjusting It on Mandrel

Difficulty of holding a rivet in place while adjusting joints of sheet-metal tubing on a mandrel for clinching may be avoided by using a tapered piece of rubber hose. This is split at the tapered end. By wedging the rivet in the split end of the hose, it will be held securely, and the hose need not be removed until the rivet is sufficiently clinched to remain in place.



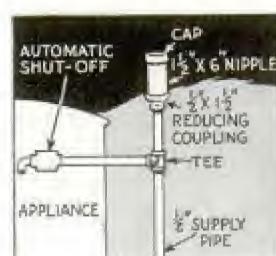
Film Spool Is Handy Carrier For Sign-Writers' Paints



Three or more small cans of paint may be carried conveniently on a sign-writing job if they are grouped around an empty film spool as shown. A large rubber band snapped around the cans will keep the assembly together, yet permit it to be taken apart quickly.

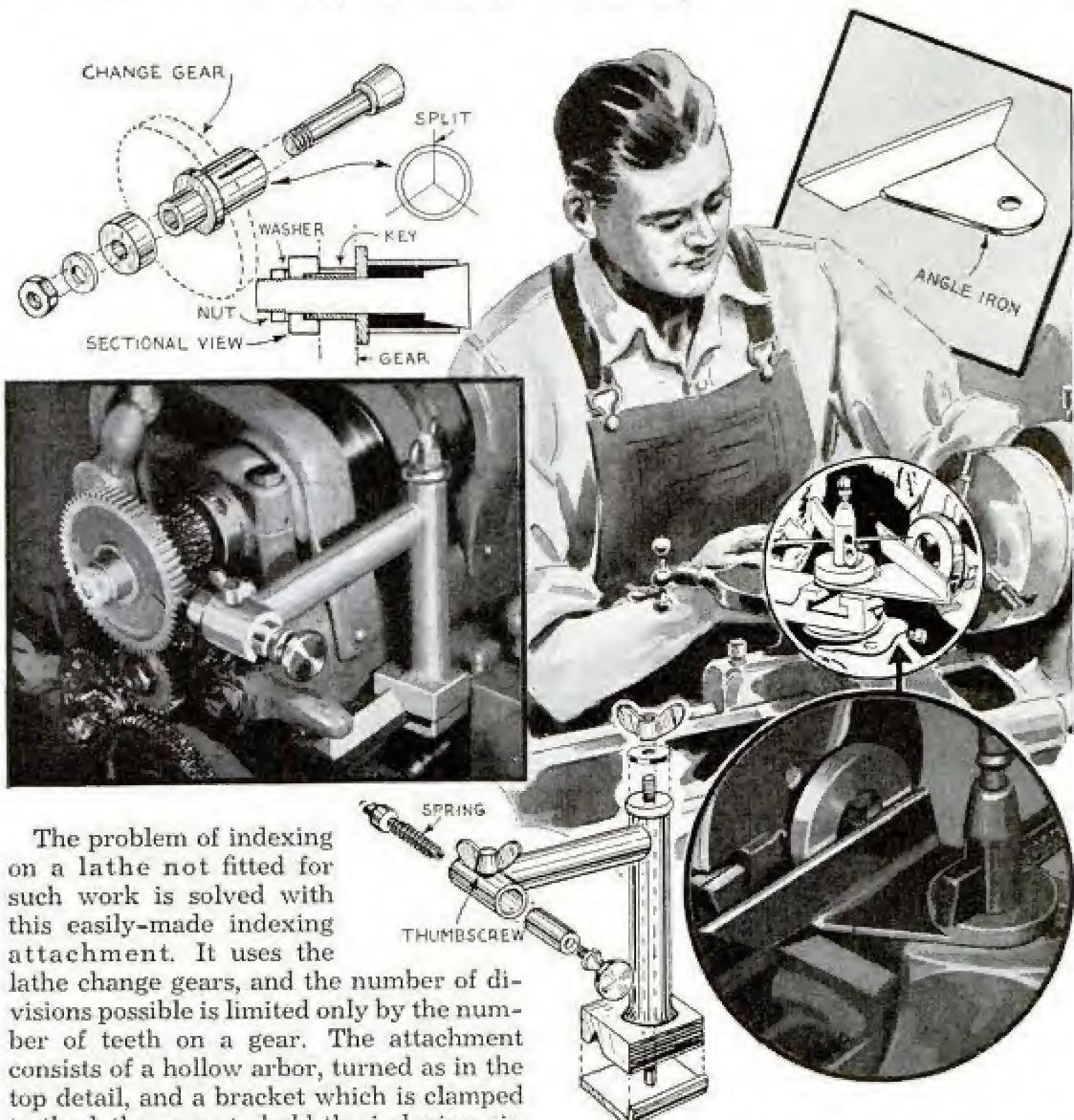
Air Cushion Stops Water Hammer

By installing an air cushion just above the shut-off valve of an automatic dish washer or washing machine, most of the water hammer caused by suddenly closing the valve, was eliminated. The air cushion consisted of a pipe nipple, cap and reducing coupling.



—Elmer O. Kling, Norwalk, Conn.

Lathe Indexing Attachment Uses Change Gears

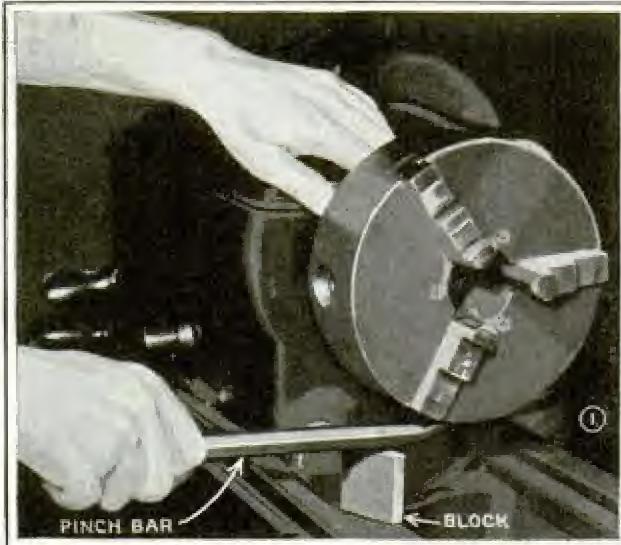


The problem of indexing on a lathe not fitted for such work is solved with this easily-made indexing attachment. It uses the lathe change gears, and the number of divisions possible is limited only by the number of teeth on a gear. The attachment consists of a hollow arbor, turned as in the top detail, and a bracket which is clamped to the lathe ways to hold the indexing pin in position. One end of the arbor is turned to take a gear and the other end is turned to fit in the hollow headstock spindle. This end is split into three equal parts so that when a taper-headed bolt is drawn up against it, it wedges tightly in the spindle. The bracket is assembled with pipe or tubing, and the housing of the bracket containing the index pin is provided with a lateral adjustment to compensate for the change gears of different diameters. Dimensions of the various parts are optional to suit your particular lathe. The end of the index pin, or detent, should be shaped to fit snugly between the gear teeth, and the spring controlling it should be quite strong to assure a positive lock. A com-

panion tool to the indexing attachment is a straightedge to aid in scribing or marking the work accurately. It is shown in the right-hand details. With it, lines exactly radial may be scored on disks, and lines parallel to the center line on cylinders may be drawn. The tool is clamped under the toolpost collar, and is made so that the horizontal edge is in line with the exact center of the spindle.

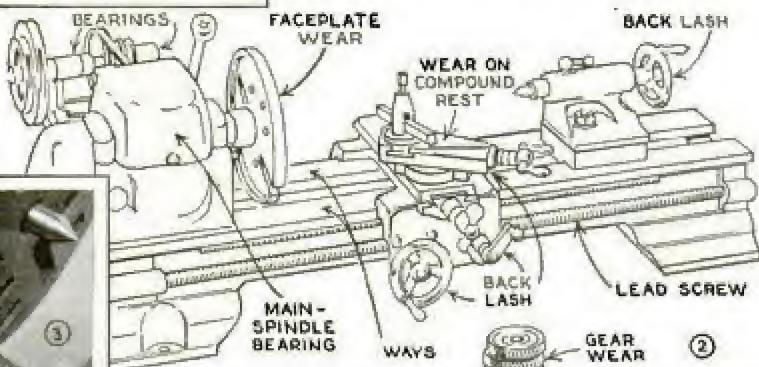
Walnut is the least apt to warp of any American hardwood. As the moisture content of the walnut evaporates, its fibers shrink more equally in all directions, avoiding undue strains and stresses that cause warping or checking.

CHECK BEFORE



Bearing wear on lathes can be checked with a pinch bar, although excessive wear can be detected even with the finger tips on the chuck or spindle

"CHECK and double check" is an axiom to take literally when purchasing used power tools. The reputable dealer won't mind the time, and will be glad to help, and it's a protection against the unscrupulous one. Glistening paint and polished metal look nice, but they won't keep worn bearings and sprung parts from making accurate work impossible. Take a metal-turning lathe for example. Fig. 2 shows the likely places to look for trouble. First check the



LOOK FOR WEAR AT THESE POINTS

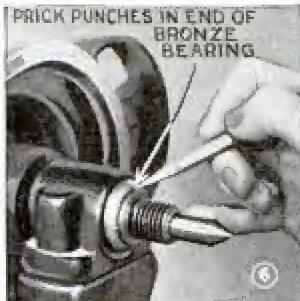


Here a dial indicator, mounted in tool post of a lathe, to bear against the faceplate, shows accuracy of the live-spindle bearings. The faceplate is turned slowly by hand



spindle bearings. Move the centers end to end by bringing the tailstock forward until they meet, Fig. 8. If you rotate the live spindle and notice that it wobbles in relation to the tailstock spindle, there is little use considering the machine for accurate turning. Another method of testing for excessive wear in bearings is to use a pinch bar as in Fig. 1, protecting machined surfaces with wooden blocks. The most accurate method of checking the live spindle is to use a dial indicator, Fig. 3. This is mounted in the tool post with its point placed against the chuck or faceplate, while the spindle is rotated slowly. In an accurate machine, vibration of the needle will be very slight. If an inaccuracy much over .001 in. is indicated, the lathe should

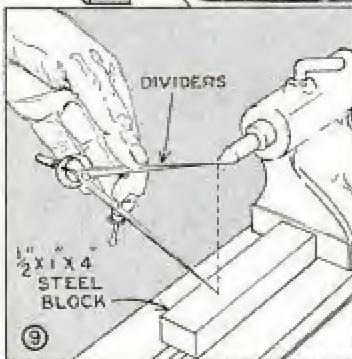
BUYING USED POWER TOOLS



Prick-punching a bearing takes up end play temporarily, and punching through oil hole forces bushing out of round



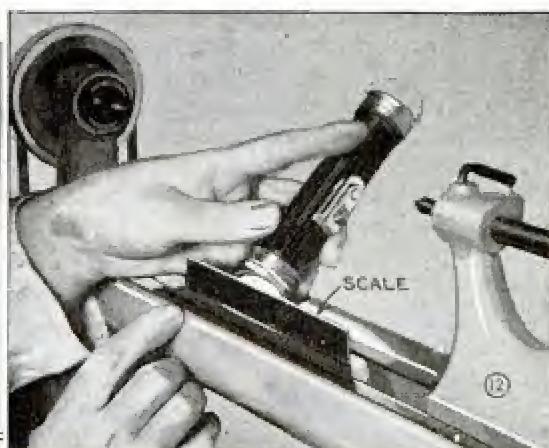
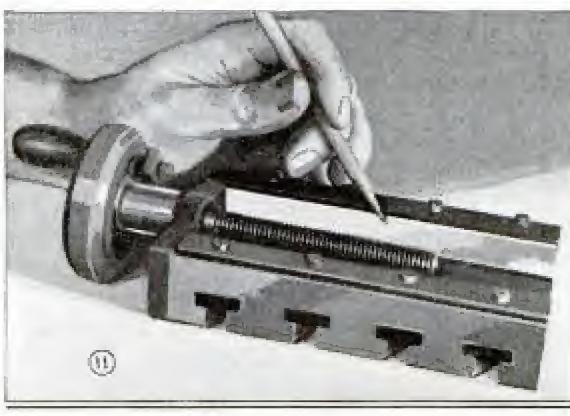
be considered second rate. Every hand-feed wheel on any machine, Fig. 4, should be turned both ways to check backlash. This is not only an index to wear but also to the age of the machine. Also in regard to tight bearings, be sure that the bearings show no signs of prick-punching, which could be done to spread and spring bearings to make them appear and feel tight. See Figs. 6 and 7. However, when examining bearings on any machine make sure not to mistake end play for wear, if the bearings are adjustable so that they can be taken up to compensate for end play. For instance, on many lathes, tapered bearings or take-up nuts and collars are provided on live spindles to make necessary adjustments. Even two-part bronze bearings on the live spindle of a lathe need skillful re-fitting occasionally to compensate for wear.

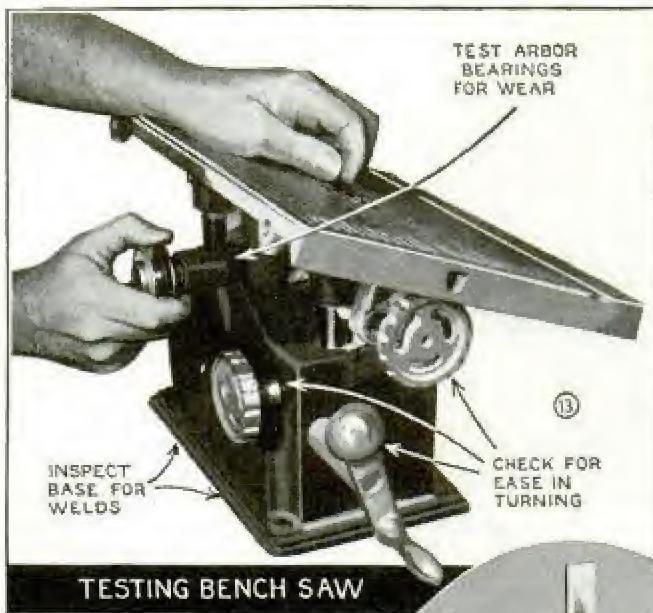


Although by no means an accurate test, two well-ground centers brought as closely together as possible will indicate bad alignment



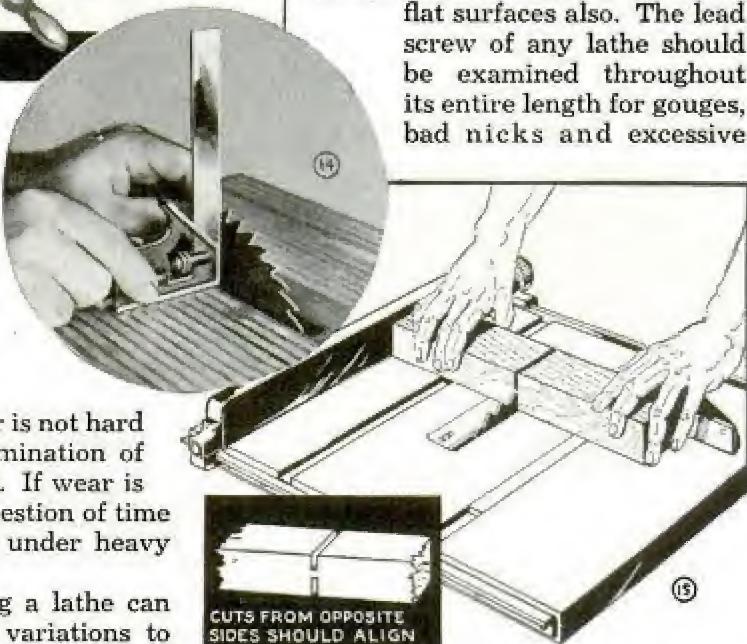
Lead screws on lathes are usually exposed to possible damage and should therefore be examined carefully for ruined threads. Below, checking for wear on lathe ways with a flashlight and a machinist's scale shows up the slightest depressions





It is important that each gear of a lathe or any other machine be examined carefully. This means an examination of each individual tooth for signs of excessive wear and also for tiny cracks which can be revealed only with the aid of a small magnifying glass, Fig. 5. In extreme cases, wear is not hard to discover by a casual examination of the contour of the gear teeth. If wear is excessive, it will only be a question of time before such gears will strip under heavy loads.

These methods of checking a lathe can also be applied with slight variations to other types of machinery. For instance, if you clamp the dial indicator securely in place, it can be used to test almost any spindle. The checking of lathe ways and other flat, machined surfaces is not so easy without expensive instruments, but you can do a fair job by improvised methods. On a lathe, inaccuracy may result from worn ways even though the centers line up when brought point to point. Therefore, the tailstock center should be checked in respect to its distance from the ways at various points. You can do this with a pair of dividers and a block of bar steel about $\frac{1}{2}$ by 1 by 4 in. which is laid on the ways as shown in Fig. 9. First, the tailstock is locked at the extreme end of the ways, making sure that the ways are wiped clean. Then the dividers are carefully adjusted



with one point on the steel bar and the other on the point of the dead center, Fig. 9. Now, the tailstock and the steel bar are moved ahead about 3 in. after which the former is locked into position again and the dividers are used to check as before. The entire length of the ways is checked in this fashion. A straightedge may also be used to check the ways. A 12-in. machinist's scale will do. By using a flashlight placed behind the scale as shown in Fig. 12, depressions little more than .001 in. deep can be detected. This method of checking can be applied to other

flat surfaces also. The lead screw of any lathe should be examined throughout its entire length for gouges, bad nicks and excessive

wear, Fig. 10. Likewise, the carriage hand-wheel, Fig. 11, should be checked for backlash by rotating it in both directions. There is not much that can be done to check chucks except to "feel-out" the jaws for play. It is well to remove one and look at the spiral for possible damage. Also take the chuck wrench and bring the jaws to a fully closed position, taking care to see how they meet at the center.

In the case of a circular saw, Fig. 14, checking with a square is advisable just to make sure that the machine has not been dropped and sprung which might place the spindle permanently out of square with the table. If a square is applied, turn the saw slowly to check at all points. An inaccuracy of only a few thousandths of an



inch will be considerably multiplied by the time it reaches the cutting edge of an 8-in. saw. If a good machinist's square is not handy, you can make the test shown in Fig. 15, if the saw can be run. It is surprising how sensitive the fingers are to wear involving spindle bearings. In Figs. 13 and 17 we see how the spindles of a drill press and a circular saw should be grasped for testing. If play can be detected



in this way, it is possible that more wear exists than you surmise. A good test on the drill press can be made by following the set-up shown in Fig. 16, using a dial indicator. This test is advisable where a machine is going to be used for extremely accurate work. When using the dial indicator in this way, the spindle of the machine is turned by hand.

Split Hose Makes a Handy Trough on Press for Gauge Pins

If the make-ready knife, gauge pins and other accessories of your job printing press are in the way on the delivery board, split a length of radiator hose and tack one half onto the side of the board to serve as a receptacle for them. The friction of the rubber will keep the pieces from sliding out at the ends, and there will be no distracting rattle when press is in operation.

Sand Holds Work for Welder

The next time you have trouble holding several small pieces in position for welding, use a box of sand. The work can be arranged in the sand, which will keep it in position while a few tack welds are made to hold it. Then the work can be removed from the sandbox and placed on the welding table to finish the job.



Milk-Can Lids Loosened Safely With Clothes-Wringer Roller



To remove bonnet-type lids from milk and cream cans, without the usual damage suffered when a stick or hammer is used, one dairyman employs the roller from an old clothes wringer. The steel shaft of the roller provides the necessary weight, and the rubber protects the lids under the most careless blows.

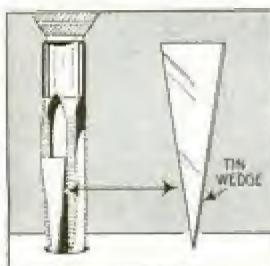
Tape Provides Nonslip Surface On Metal for Compass Point

One workman avoids making an indentation in sheet metal for the center point of a compass, when using the instrument in layout work, by using electrician's tape as indicated. This is placed on the metal where it adheres firmly to keep the compass leg in place.

—G. E. Hendrickson, Argyle, Wis.



How to Make Tap Cut Oversize



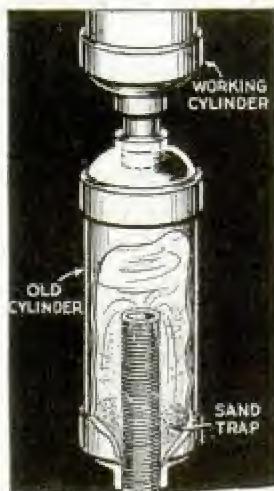
A simple method of making a tap cut oversize is as follows: After the hole in work has been tapped, wrap a piece of cotton cloth or waste around the tap and

rethread the hole. This will cause the tap to enlarge the hole slightly. If this is not enough, you can make it still larger by using a wedge-shaped piece of tin as shown. This is merely inserted into one of the flutes of the tap, after which the hole is rethreaded. The tin tends to push the tap to one side.

—Wm. Dettmer, Port Chester, N. Y.

Old Cylinder Used as Sand Trap On Well-Pump Pipe

One farmer keeps sand from being sucked into the cylinder of his well pump by installing a discarded cylinder next to the lower end of the one in use. The pump pipe projects well up into it as indicated, so that any sand sucked into it drops to the bottom and does not pass into the cylinder containing the piston. Putting a pipe plug in the bottom of the extra cylinder permits removing the sand.



Flashlight Held in Wrist Bracket Leaves Hands Free

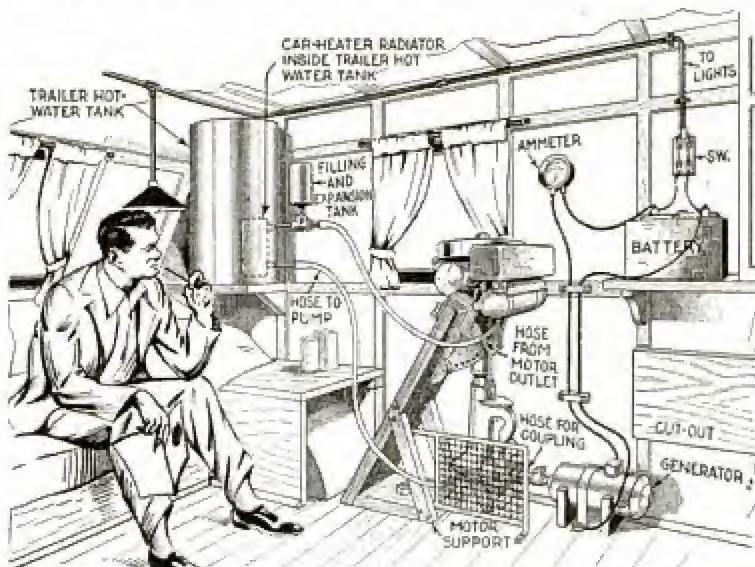
Instead of using one hand to hold a flashlight while working in dark places, electricians and others can have both of their hands free by using a bracket like the one shown to hold the light on one of their wrists. The bracket is the clamp part of a steering-column flashlight holder. It is riveted to a soft-leather strap, which is buckled around the wrist. If the rivet heads tend to chafe the wrist, a strip of adhesive tape stuck over them will stop the trouble.

—F. W. Edwards, Barnesville, Ohio.



Outboard Gives Lights and Hot Water in Trailer

A small outboard motor can be used to provide electricity and hot water for use in a house trailer. And it takes but a few minutes to remove or replace the motor when it is wanted on a boat. If possible, the installation should be made at the rear of the trailer, outside the living quarters. The best unit includes a small, high-speed motor, a heavy-duty auto generator and a large size radiator core from a car heater. A hardwood motor support should be bolted to the trailer floor. Keep the motor as low as possible so that the skeg, or propeller guard, just touches the floor. The generator is lined up with the propeller shaft, and the two shafts connected with a piece of water hose clamped in place to serve as a flexible coupling. Cooling of the motor and heating of the water is accomplished as follows: Inside the hot-water tank of the trailer is mounted the core of the hot-water heater. This serves as a radiator for



the motor and at the same time heats the water in the tank. It is connected to the motor by auto-heater hose. Only one detail needs special attention. This is the arrangement of a combined filling and expansion tank, which has its top slightly above the height of both the motor and the water level in the hot-water tank. Wiring is conventional, there being an electric cutout on the generator.

—C. E. Packer, Chicago.

Pencil Clip Holds Yard Goods on Counter for Measuring

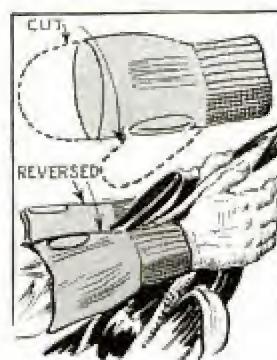
To keep yard goods stretched for easy measuring, one merchant tacked a pencil clip to the counter. In use, the end of the

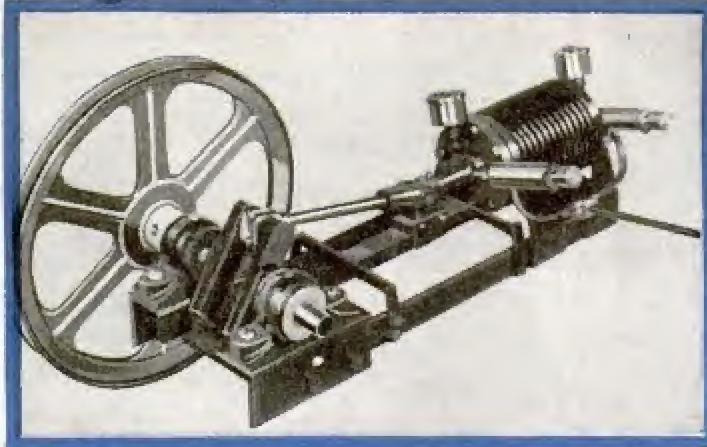


cloth is slipped under the clip, after which the bolt of cloth is unrolled. The cloth will be held more securely if a rubber-headed tack is driven into the counter under the end of the clip. The rubber provides friction against the cloth to prevent slipping.

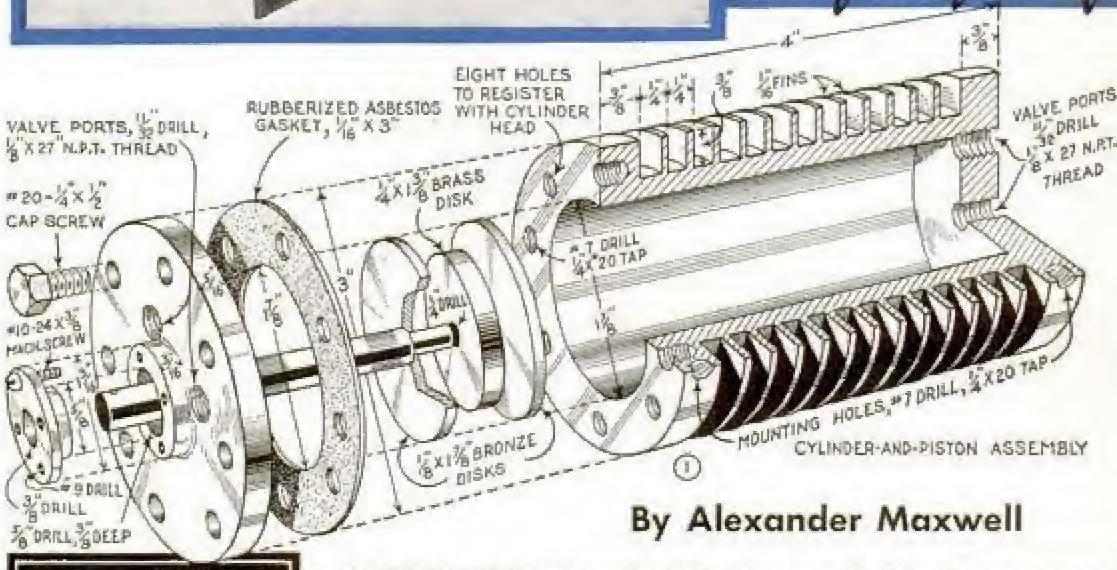
Mittens Make Wrist Protectors For Corn Harvesters

To avoid scratched wrists when handling corn fodder, one farmer uses discarded mittens as wristlets. The finger portions are cut off and the remaining sections are pulled over the coat sleeves.





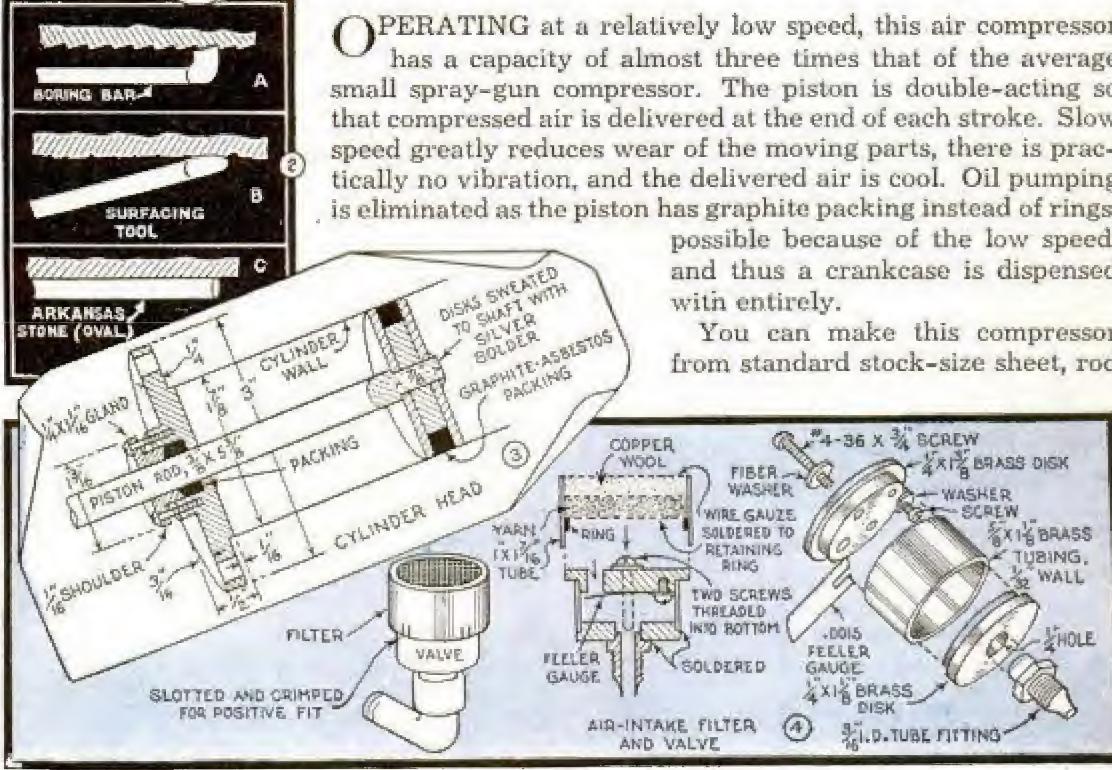
Large Capacity



By Alexander Maxwell

OPERATING at a relatively low speed, this air compressor has a capacity of almost three times that of the average small spray-gun compressor. The piston is double-acting so that compressed air is delivered at the end of each stroke. Slow speed greatly reduces wear of the moving parts, there is practically no vibration, and the delivered air is cool. Oil pumping is eliminated as the piston has graphite packing instead of rings, possible because of the low speed, and thus a crankcase is dispensed with entirely.

You can make this compressor from standard stock-size sheet, rod



CLEANING SHOP TOOLS



OPERATING FORGE



PAINT SPRAYING

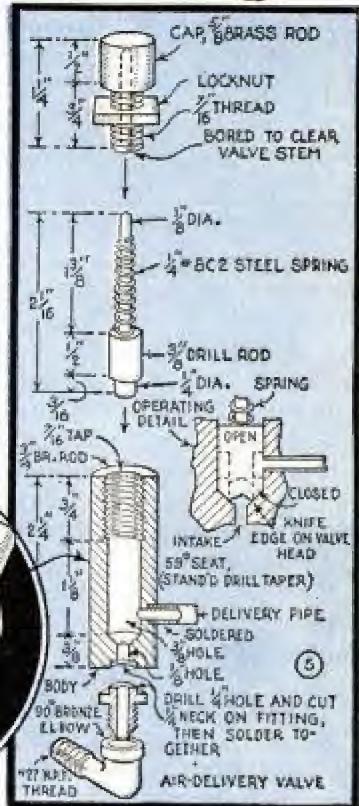
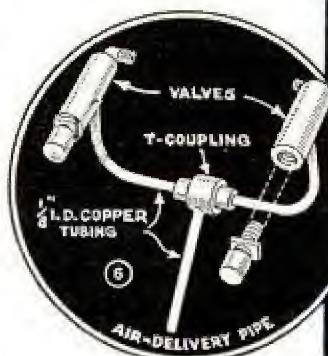


Double-Acting AIR COMPRESSOR

and tubing, except for the cast bearings and elbows. All the parts must be fitted accurately to eliminate pounding. The cylinder Fig. 1, is turned to 3 in. in diameter, from a length of mild steel rod. Often short lengths of this can be obtained from junk dealers who buy up mill ends. Face the ends and saw off a $\frac{1}{2}$ -in. disk to use as a cylinder head. With the remainder cut to length, chuck it in a lathe, between a four-jaw chuck and tail center, and cut the fins. Start these with a V-point tool, working in as deeply as possible, then true up the edges with a chisel-point tool. Repeat this procedure until the required depth has been reached. Boring the cylinder is a long and tricky job. Mount it between the reversed jaws of a chuck and start by drilling a hole large enough to accommodate the smallest boring bar, which is used until the bore will accommodate a larger one. After completing the last cut to within .01 in. of the finished bore, the bored surface will appear quite smooth, but under a magnifying glass it appears as shown in detail A of Fig. 2. Then you use a surfacing tool as in detail B, taking "microscopic" cuts by running the carriage back and forth without advancing the feed. Finally you hone the surface with a well oiled Arkansas stone as in detail C. The work should rotate about 500 r.p.m., and the stone is moved back and forth with one finger until the bore is mirror bright.

The piston, Figs. 1 and 3, must fit practically airtight, even without packing. Silver-solder the bronze and brass disks to the piston rod before turning them to size, and finally remove only .001 in. of metal per cut, stopping when the piston shows signs of sliding into the bore. Then wrap the piston in cotton and put it where it will not be damaged.

Now go to work on the cylinder head. Face the inside while



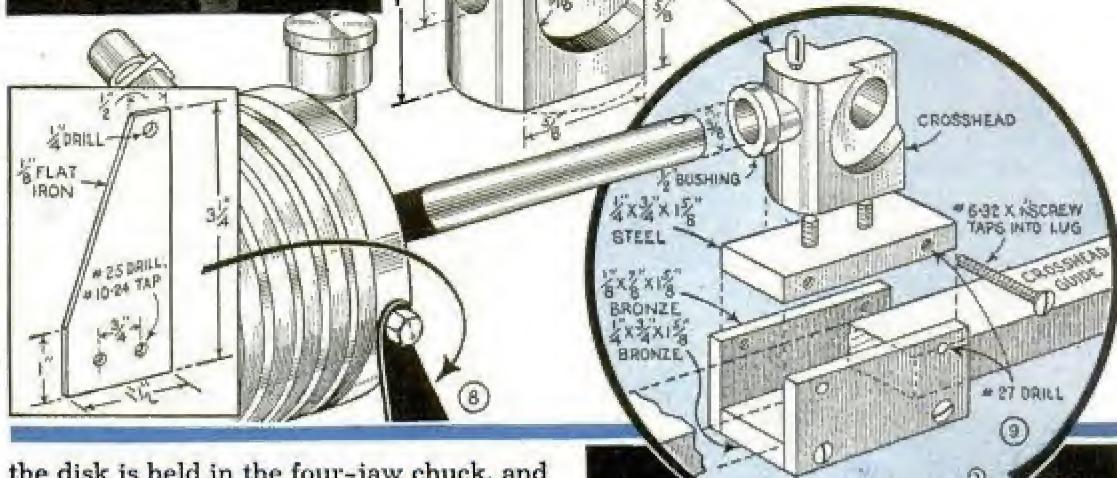


head on a block of wood, and drilling down through the head.

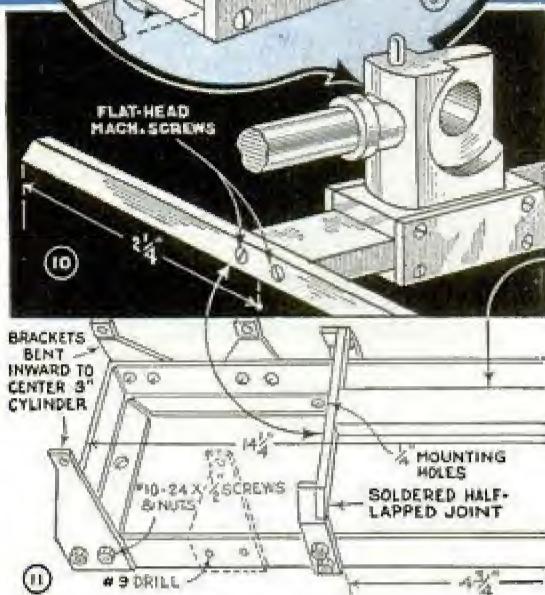
When the head is screwed down, the piston should center itself without binding. Wrap $\frac{1}{4}$ -in. graphite-asbestos rope packing, used for low-speed pumps, into the piston groove so that the packing bulges out but keep working it into the groove until the piston enters the cylinder. The packing is woven, so don't cut off stray bulges, but work them in. A couple of drops of oil put in the intake valves each hour of operation will replace any grease lost from the piston packing.

An intake and exhaust valve are fitted at each end of the cylinder. The intake valve, Fig. 4, has a thin, flat piece of steel, such as a piece of feeler gauge, fitted over a hole in the cover. On the suction stroke it bends

away from the hole and air enters, but on the pressure stroke it is forced against the hole and air in the cylinder can escape only through the exhaust valve. To prevent dust or paint from being sucked into the cylinder, a filter cap may be slipped over



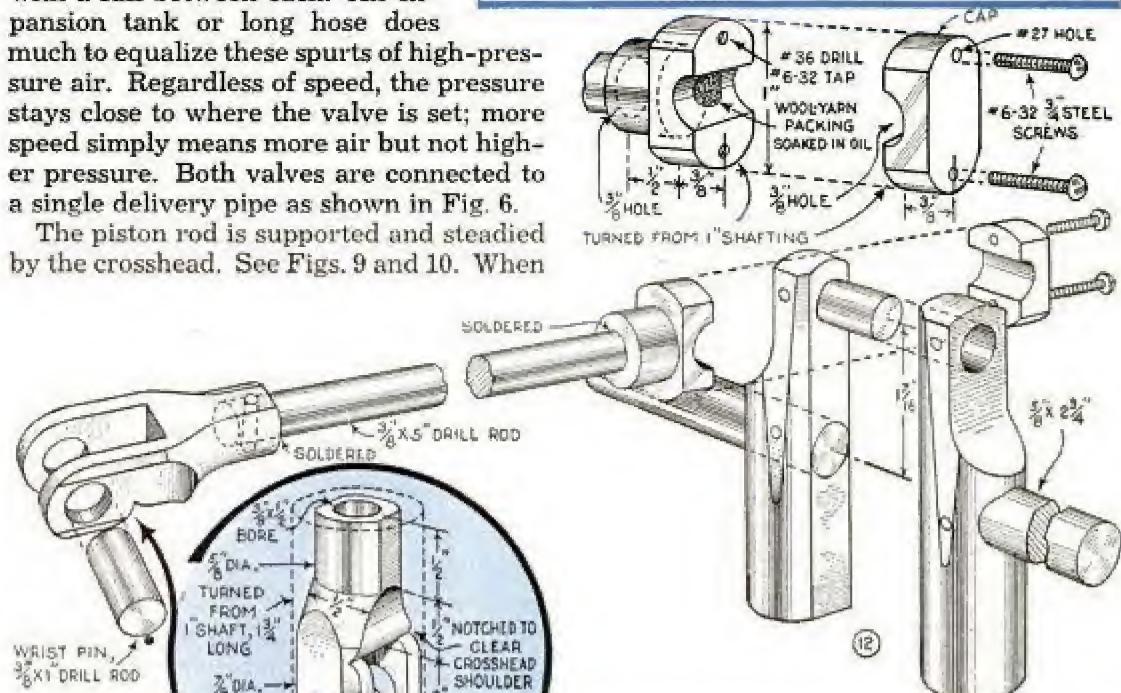
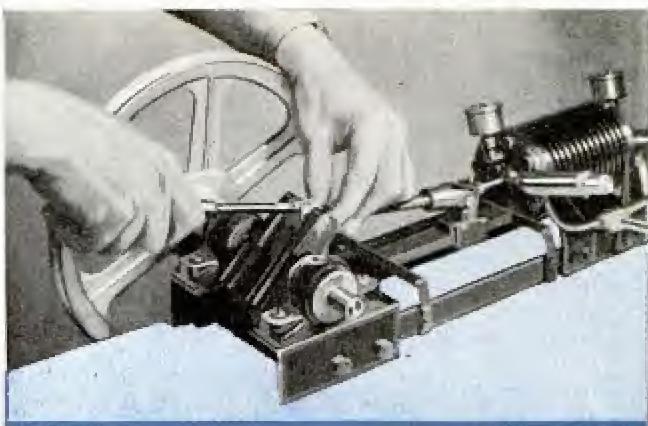
the disk is held in the four-jaw chuck, and cut the retaining shoulder for the gasket, Fig. 3. Bore for a running fit on the piston rod, then face the outside of the head and bore the stuffing box. Turn the cover or gland from brass. With the cover in place, drill and tap for four mounting screws, installing each screw before the hole for the next is drilled. The same procedure is followed for the eight cylinder-head screws. Drill one hole into both head and cylinder, tap the latter and counterbore the head for body clearance. Screw down this one and then drill the hole exactly opposite. Two taps are required: a tapered one to start the thread and a bottoming one to carry the thread down to sufficient depth. A gasket of rubberized asbestos is cut to size and the holes pierced by laying it and the



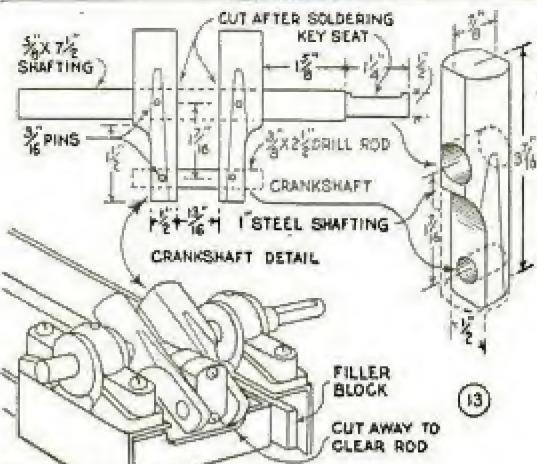
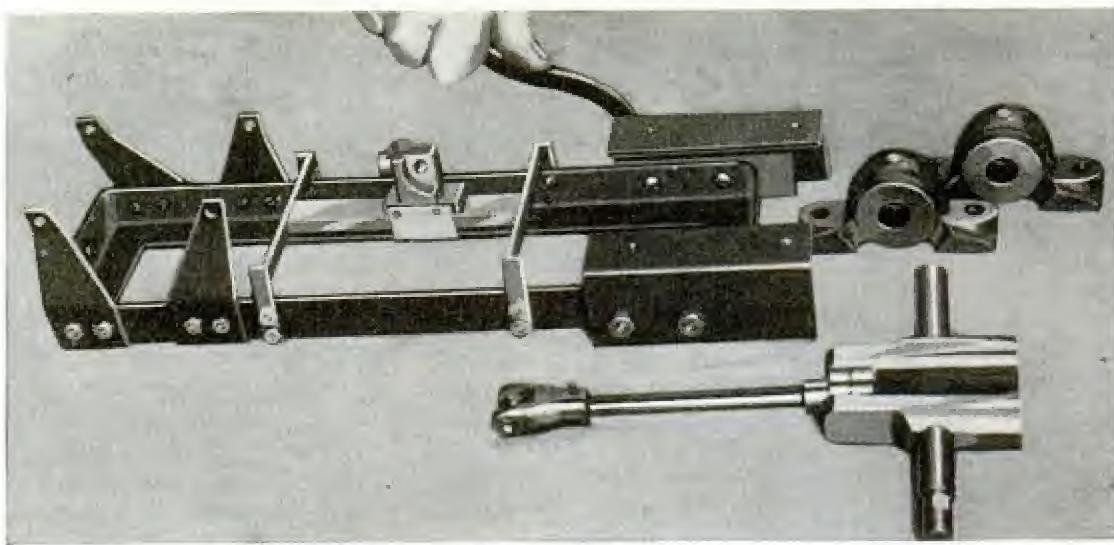
each valve. When the filter pads become clogged with foreign matter they are replaced.

The exhaust or delivery valve shown in Fig. 5 is more complex, for it works under pressure and at a rather high temperature. The strength and adjustment of the valve-stem spring determines the pressure of the delivered air. On low-pressure, the delivery of air is almost a steady stream, but on high pressure, it comes in spurts with a lull between each. An expansion tank or long hose does much to equalize these spurts of high-pressure air. Regardless of speed, the pressure stays close to where the valve is set; more speed simply means more air but not higher pressure. Both valves are connected to a single delivery pipe as shown in Fig. 6.

The piston rod is supported and steadied by the crosshead. See Figs. 9 and 10. When

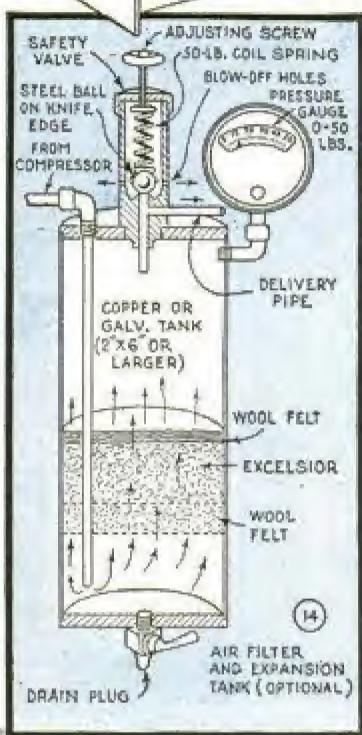


installing the brass bushing, drive it in first, then bore out to a tight running fit. A pin holds the piston rod in the bushing and crosshead. As the latter is subjected to extreme stress, accuracy in construction is important. The sliding sleeve on the crosshead guide is also detailed in Fig. 9. Fig. 10 shows the guide and how it is attached between brass cross-pieces, which later are soldered to brackets on the base, Fig. 11. The crankshaft, Figs. 12 and 13, runs in heavy bronze bearings, shown removed from the unit in one of the photos. The crank is made from standard steel shafting. The heavy butt ends are counterweights. Drive them onto the shaft, drill and pin them in place, driving each.



SPEED AND COMPRESSOR DELIVERY TABLE				
Comp. Pulley	Motor Speed	Motor Pulley	Comp. Speed	Air Delivered
10 in	1725 R.P.M.	1 in.	172 R.P.M.	2.74 Cu. Ft. per M.
		2 in.	295 R.P.M.	4.62 Cu. Ft. per M.
		3 in.	458 R.P.M.	6.58 Cu. Ft. per M.

For higher speed the size of valve parts must be increased. Maximum delivery not to exceed 8 cu. ft. per minute and pressure not greater than 50 lbs.



pin in firmly. Then sweat-solder the parts together, using zinc-alloy solder, after a liberal application of stainless-steel flux, by laying the assembly on an asbestos pad over a gas plate as in Fig. 7. Bring up the temperature to the point where the flux boils, then apply solder and give it time to penetrate clear through the joints. When cool, wash well in warm water to remove remaining flux, and paint with black machinery enamel.

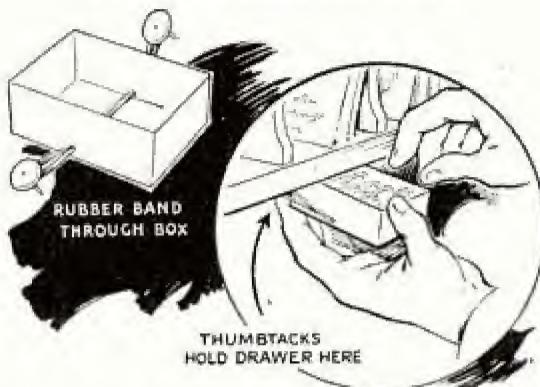
The connecting rod between the crosshead and crank-shaft is also shown in Fig. 12. It consists of three parts soldered together. Leave the soldering of one end until the entire compressor is assembled and centered. The crank bearing is lubricated by a pad of wool yarn in a cavity in the bearing. See upper detail of Fig. 12. Take up the screws until there is no slack in the cap, but stop before binding starts. The bearing on the crosshead, detailed in the circular insert of Fig. 12, requires considerable hand filing after the lathe work is finished, so that it will not catch or bind.

The base, Fig. 11, is a length of angle iron, notched and bent to shape, with the end secured by a corner iron. Tap holes in the frame, screw the iron in position, solder, then file the screw shanks off flush. Three mounting holes are drilled to hold the base on a wood sub-base. The

crankshaft-bearing supports are pieces of angle iron spaced from the base as shown in the extreme right-hand detail of Fig. 11. The center of the crank must be in line with the end of the piston. As misalignment of only .01 in. will cause the shaft to bind, be prepared to shim up one or the other of the bearings. The cylinder is held by four brackets bolted to the base and to the cylinder. See Figs. 8 and 11. The crank is centered so that there is a slight air gap at each end of the piston stroke. Then the guide rod is slipped in place and, after letting it center itself between the two supports on the base, brass crosspieces are soldered to the supports, using zinc-alloy solder and stainless-steel flux. Stick graphite is the best lubricant for the guide, cross-head and crank, with a few drops of machine oil added from time to time. The table, Fig. 15, gives information on the volume of air delivered at three speeds, together with pulley sizes.

When doing lacquering and fine painting, the presence of water in the air is detrimental. Fig. 14 shows an air filter with a pressure gauge and safety valve attached. The gauge and valve are standard items, the tank can be made of brass or galvanized iron.

Matchbox and Rubber Band Good Drawer for Clips



If you dislike to keep a box of paper clips on your desk or in a drawer, punch a couple of holes in a matchbox and thread a rubber band through them. Then attach the box underneath the pigeonhole shelf of the desk with thumbtacks through the looped ends of the band. This gives you a handy container for paper clips or pins that is easy to get at, yet it is out of sight and out of the way.

Steel Sheets Used as Turntable For Heavy Crates



When crates or boxes of heavy machinery are to be moved or located at any point on a shop floor by means of roller shafts, much of the delay caused by twisting the rollers to carry the load around corners can be avoided by using a couple of pieces of sheet steel as a turntable. These are placed one on top of the other and the crate rolled onto them. Then the upper one is twisted around to turn the crate, the lower sheet providing a smooth bearing surface.

Snow Fence Built in Sections Is Easy to Fold and Store

Built in easy-to-handle units, this snow fence folds into a compact space. Each unit is made of 1 by 6-in. boards spaced 2 or 3 in. apart, and nailed to 2 by 4-in. strips. Braces of the same stock pivoted at the top of the strips support the fence.

—Dale R. Van Horn, Lincoln, Nebr.



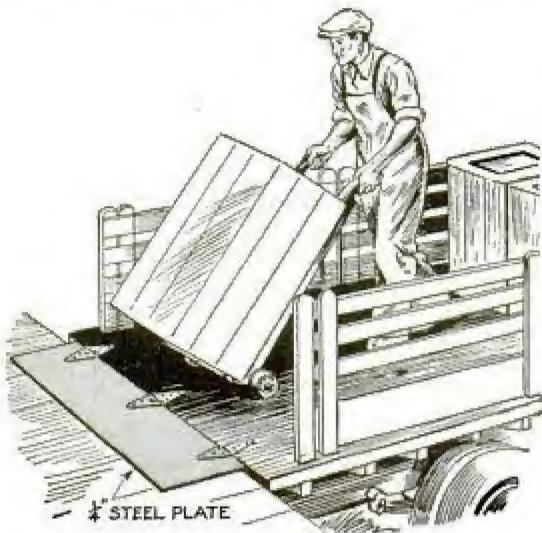
Auto Hood Clamps Spread Tire To Repair It on Bench



In order to keep large tires spread for inspection or repairs, one mechanic used a couple of auto-hood clamps. These were spaced and screwed to the workbench top so that when a tire was placed between them they could be hooked over the beads.

'Bridge' Hinged on Rear of Truck Aids Driver in Loading

Having a truck not fitted with a tailgate that was suitable to bridge the space between the truck and most loading platforms, one driver made a bridge from steel plate. This was hinged to the rear end of

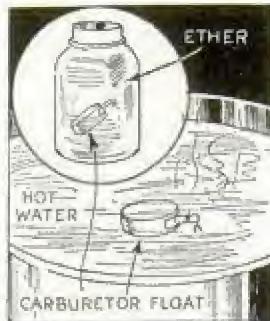


the truck bed so that it could be folded back on the bed when not in use, or raised up against the load to serve as a tailgate.

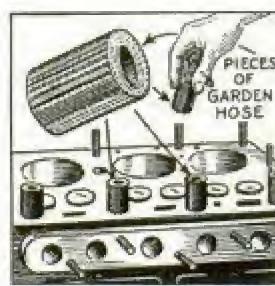
Locating Tiny Leak in Float Of Carburetor With Ether

An improvement over the usual method of submerging a carburetor float in hot water to find a leak, consists of submerging it in motor ether for a few hours. Then when the float is submerged in hot water, rapid vaporizing of the ether caused by the heat will provide sufficient pressure inside the float to make bubbles appear.

—Guy E. McAllan, Fernie, B. C., Can.



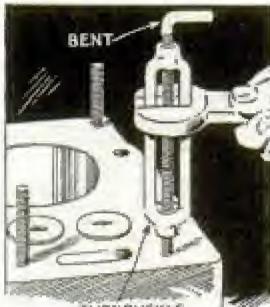
Rubber Shields on Motor Studs Protect Mechanic's Hands



When working on a motor block from which cylinder-head studs are projecting, one mechanic slips pieces of hose over the studs. With this protection, there will be no injury to a workman's hands should they strike the studs when a wrench slips.

Stud Remover From Turnbuckle

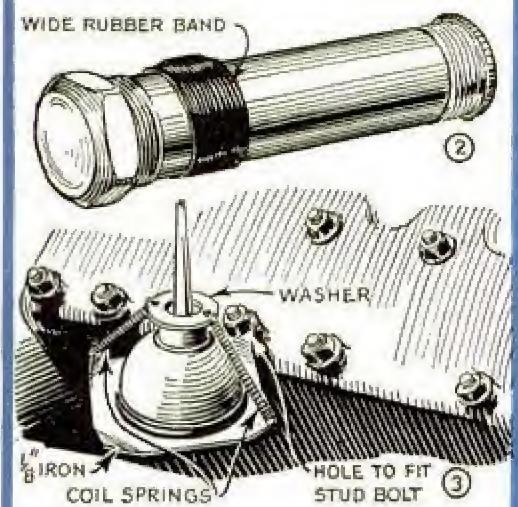
You will find that a turnbuckle can be converted into a handy stud remover or driver. Just remove one of the screws from the buckle and bend the outer end of the other one at right angles as shown. In use, turn the buckle down on the stud and then run the screw in the other end of the buckle down tightly on the end of the stud. Use a wrench on the turnbuckle to remove the stud.



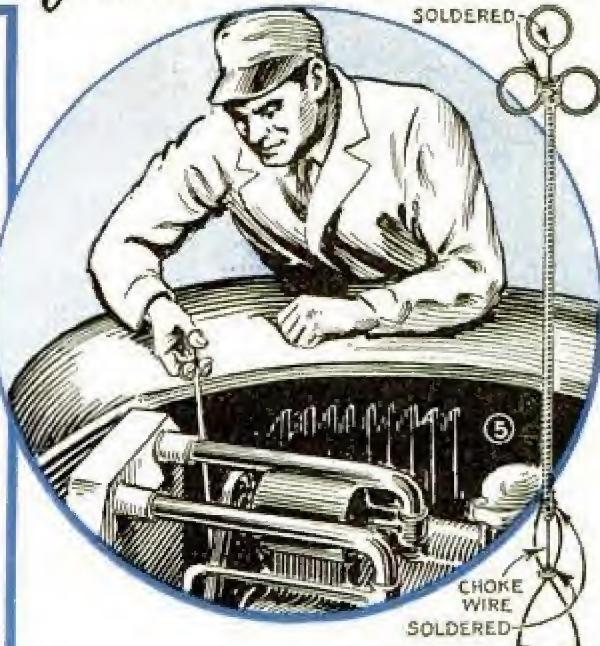
HELPFUL HINTS for the MOTORIST



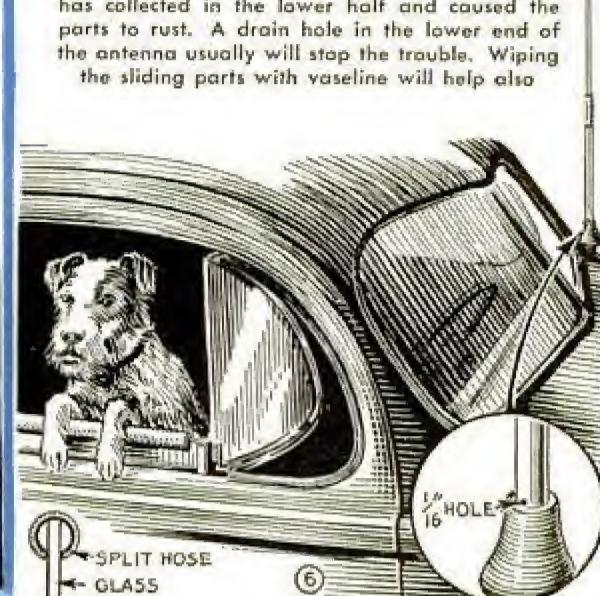
1—If you can raise your car hood from the outside, the carburetor air cleaner is a good place to carry a spare ignition key.
2—Slipped over the switch of a flashlight, a wide rubber band will help prevent the light from being turned on accidentally.



3—Clamped under one of the cylinder-head bolts of the motor, this holder permits an oilcan to be carried under the hood where it is conveniently at hand.
4—Your road map is always ready for instant viewing if it is kept on the inside surface of the glove-compartment door. Four small spring clips soldered at the corners of the door will keep the map in place.



5—Recovery of nuts, washers, wrenches and other small parts is a simple matter with this tool if they have been dropped around a hot motor or in other places difficult or impossible to reach with the hand. The spring-wire jaws, which pass through a small ring soldered to the lower end of the choke wire, are opened or closed when the latter is moved up or down by the finger ring soldered to the upper end of the choke wire.
6—Instead of lowering a window all the way so your dog can put its feet on the frame to look out and maybe scratch the finish, slit a piece of hose to fit over the edge of the glass, which is then left raised slightly. This is comfortable for the dog and keeps its feet off the finish. If your telescoping antenna works hard, moisture probably has collected in the lower half and caused the parts to rust. A drain hole in the lower end of the antenna usually will stop the trouble. Wiping the sliding parts with vaseline will help also.



"Bottle-Fed" Motor Gets Home When Fuel Pump Fails



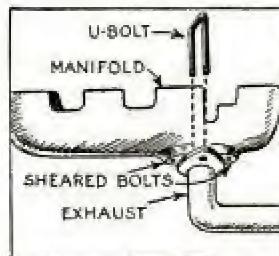
If your fuel pump fails out on the road, you can save a tow home or to a garage by using a bottle to feed fuel to the motor. Just take an empty ginger ale or other similar bottle, fill it with gas and press a cap on it tightly. Then make a hole in the cap, remove the air cleaner and invert the bot-

tle into the carburetor. Start with a tiny hole in the bottle cap and then enlarge it by experiment until it passes enough gas to keep the motor running at a slow road speed. This is necessary as there is no way of slowing or speeding up the motor in traffic or when you have to stop. De-clutching or changing gears will enable you to reduce speed or stop the car whenever necessary.

—C. Longnecker, Jr., New Brighton, Pa.

Repairing Exhaust-Pipe Bolts Broken at Manifold

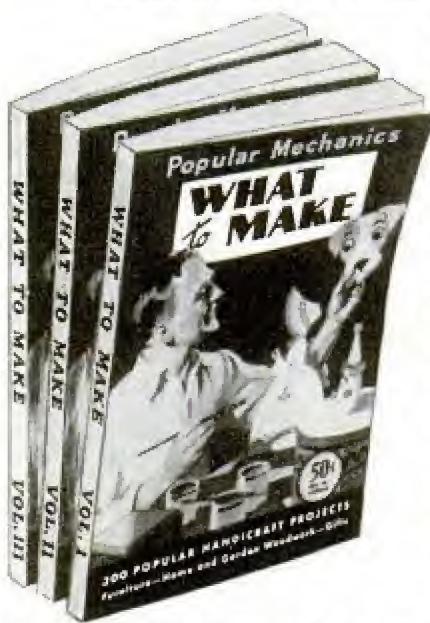
When the bolts that hold the exhaust pipe to the manifold of a popular car sheared off, a repair was made as shown. The clamp plate of the pipe was turned 90 degrees and a U-bolt around the manifold used to hold it in place. Such a repair saves time too, because the manifold does not have to be removed.



—W. H. Heaton, Jr., Ooltewah, Tenn.

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RADIO

INNOVATIONS for 1942

"FM" RECEIVERS and adapters, automatic radio-phonograph combinations and table model televisors of compact design, offer a variety of comparatively inexpensive advanced forms of electronic entertainment at the beginning of the new year.

Although television programs are available only in a few metropolitan localities at the present time, they are being received with favorable comment. Movies, sports and spot news are even brought aboard small pleasure boats by means of television. Photo A shows a compact table model sight-and-sound receiver installed aboard the 33-ft. cabin cruiser "Hurricane II." New York City television stations are being picked up at distances up to about 50 miles.

Entertainment for all is provided by radio-



phonograph combinations in the table model size, photo B. Several of these types feature the automatic record changer. This six-tube receiver has a built-in antenna.

Frequency modulation broadcasts, now on regular program schedules in many of the larger cities offer a new form of radio reception that is thrilling listeners. These "FM" stations broadcast speech and music of

natural quality with a minimum of static and man-made interference. To receive these broadcasts it is necessary to have an "FM" receiver or an attachment on your present radio. An "FM" adapter of this description is shown in photo C. All "FM" broadcasting tunes between 42 and 50 megacycles, in the ultra-high frequency short-wave band; a megacycle is 1,000 kilocycles. Practical receiving range is 50 or 60 miles.

TWO-BAND MINIATURE-TUBE



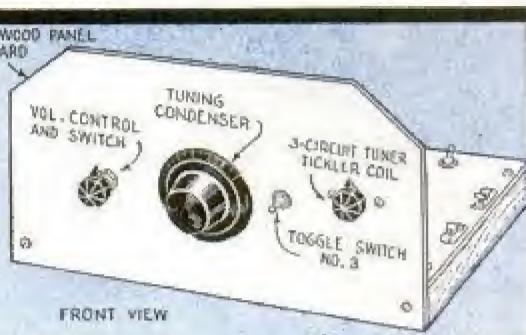
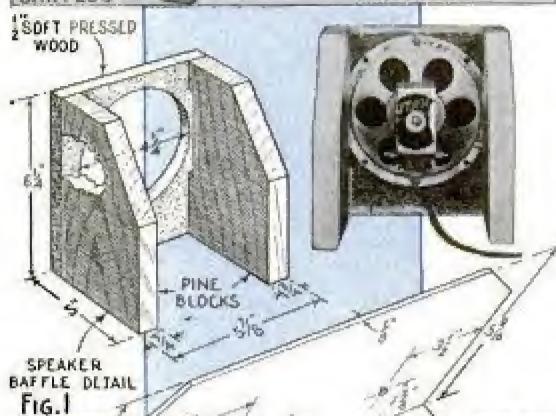
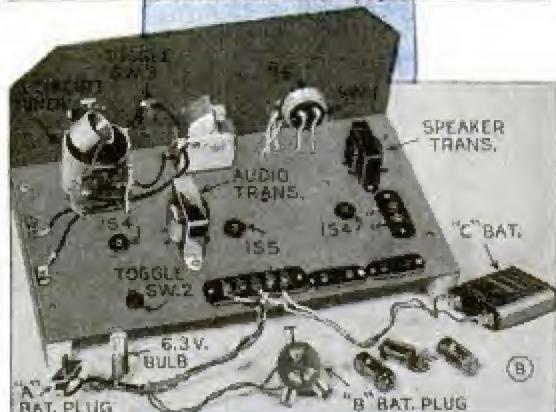
BATTERY-OPERATED BROADCAST RECEIVER
AND "WIRELESS" RECORD PLAYER

By Stanley Johnson

WITH miniature tubes operating at low plate voltage and simple inexpensive "breadboard" construction, this new three-tube version of the popular two-band flashlight-battery receiver makes an ideal "second set" for radio beginners.

Although it is low in cost and easy to build, it is an excellent performer. With a good antenna and ground, it is capable of bringing in just about all of the stations that can be picked up on the usual home radio. It covers not only the broadcast band, but also the 160-meter and 80-meter amateur bands, and includes the police and aircraft bands. Furthermore, a simple switching arrangement makes it possible to use the set as a "wireless" oscillator for playing phonograph records through any other receiver in the home. When a record player is connected to the terminals provided on the receiver, and switch No. 2 is thrown to the "broadcast" position, the set puts out a signal which is easily tuned in on the other receiver as illustrated in photo C.

The 5-in. speaker is installed in a separate baffle unit, details of which are given in Fig. 1. Two pieces of $\frac{1}{8}$ -in. hard pressed wood are used for the base and front panel; the base panel is supported on wood strips which permit under-base wiring and provide a firm mount for the front panel. Complete drilling and assembly details are shown in Fig. 2. The simplified wiring diagram Fig. 3 is an "X-ray" view looking down on the top of the base. Photos A, B,

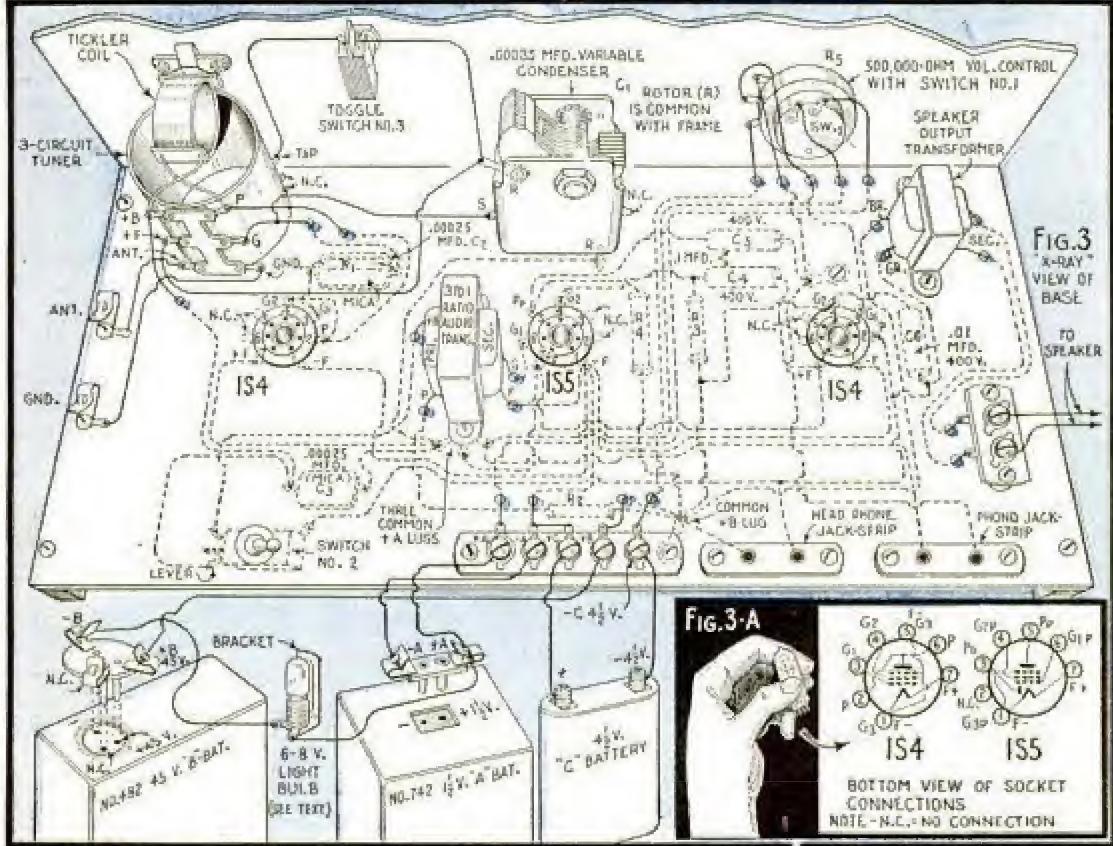
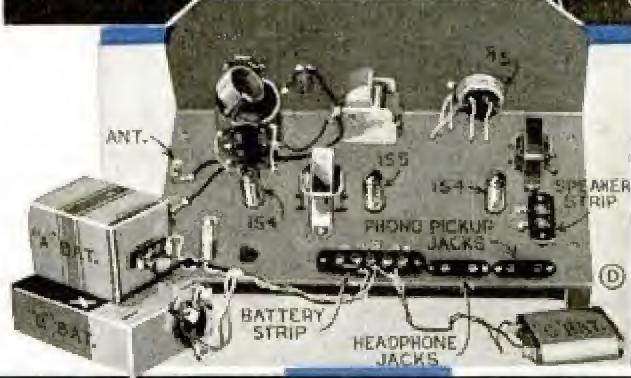
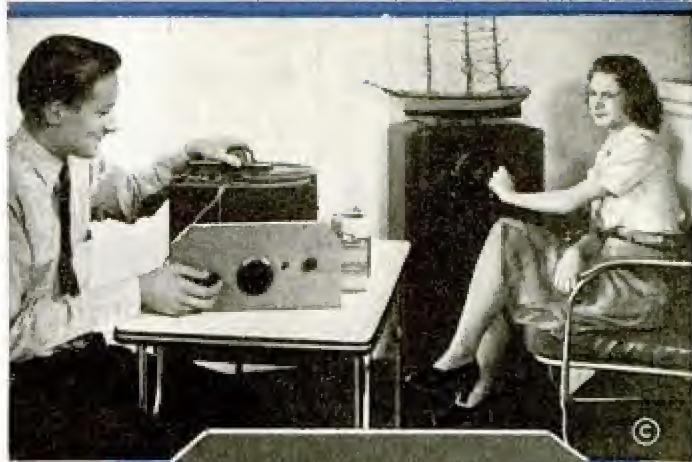


SET *and* PHONO OSCILLATOR

D and E show various views of the completed set.

In mounting the parts, start with the tube sockets. These are inserted in the $\frac{5}{8}$ -in. holes drilled in the baseboard, and secured by forcing on the retainer rings. Next mount the variable condenser (C_1), transformers, and the terminal strips for the loud speaker and battery connections. These terminal strips are raised above the panel by means of $\frac{1}{2}$ -in. bushings. Holes are cut for mounting the two twin-jack strips directly on the base panel, the terminals extending below. Finally install the 3-circuit tuner, switches and volume control. The 95c 3-circuit tuner unit is a conventional type tapped for short wave. It is

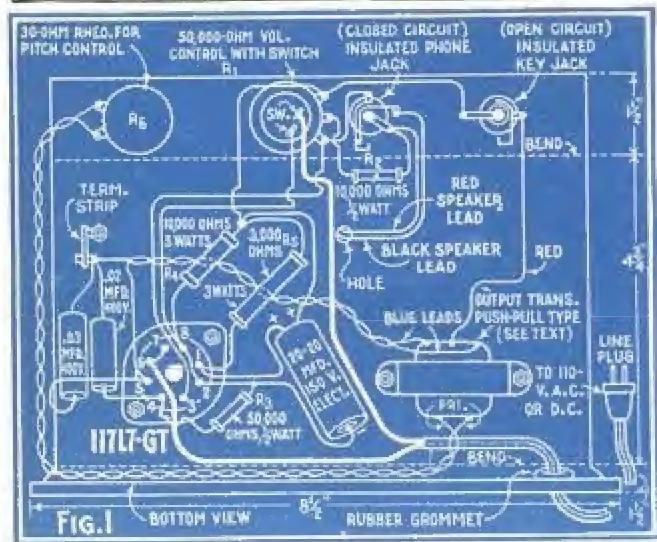
(Continued to page 182)



Code-Practice Oscillator Unit for Large Groups



A black and white photograph of a vintage audio component. At the top, the words "WIRE SCREEN" and "5" MAGNETIC SPEAKER" are printed above a circular metal frame. Inside the frame, a speaker cone is visible. To the right of the speaker is a cylindrical vacuum tube. The entire assembly sits on a dark rectangular base. On the front panel of the base, the text "HTL7-6T" is printed. A small circular label with the letter "A" is located in the bottom right corner. A line cord is attached to the bottom left of the base.



THIS simple a.c.-d.c. oscillator unit for code practice includes all of the latest features recommended by training instructors. It is easy to build, and all parts, less the tube, cost only about \$5.50 at present prices. Operating directly on any 110-volt line, the 117L7-GT tube eliminates ballast tubes or dropping resistors.

Continuously variable pitch control over a wide range provides a means for adjusting from a high to a low pitched signal to suit students' personal preference. The signals sound just like CW signals on the air, coming through crisp and clear with practically no harmonic distortion, and a minimum of key clicks. Another feature is variable volume control; this permits control of the signal from a low level for a single headphone, to high volume for operation on a classroom table provided with up to 20 sets of headphones. The built-in speaker may be employed if preferred; this speaker is cut out of the circuit when the phone plug is inserted in the phone jack.

Cost of construction may be further reduced by using a wood baseboard and a plywood panel instead of the metal base and panel shown. Another suggestion would be to employ $\frac{1}{8}$ -in. hard pressed wood supported by wood strips on each side of the base; make the panel of the same material. All base and panel dimensions are given in the simplified wiring diagram Fig. 1 and photo B. Photos A and C show top and underside views of the completed unit; the schematic circuit dia-

gram appears in Fig. 2 and all parts values are clearly indicated in Figs. 1 and 2. The only critical part is the output transformer;

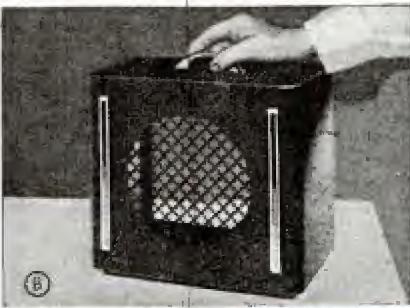
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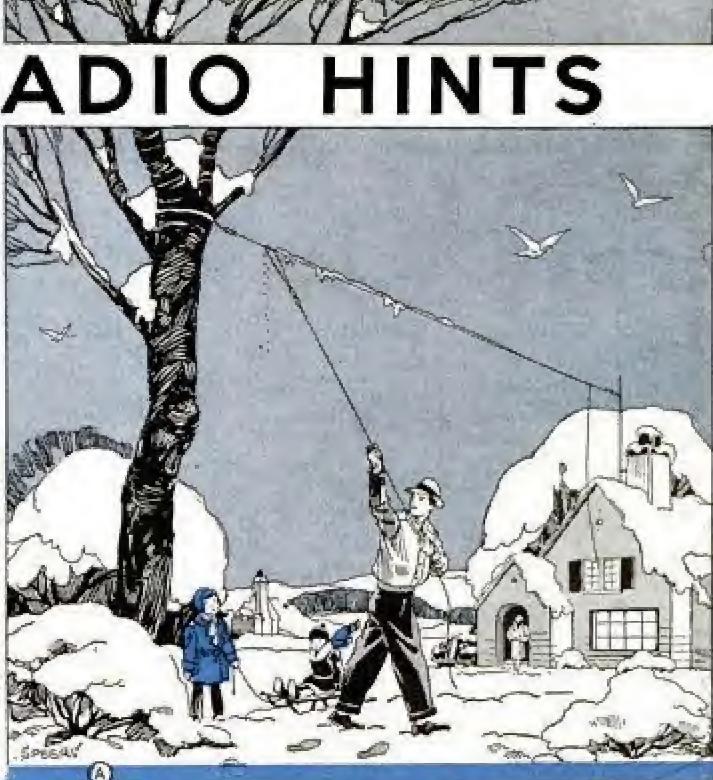
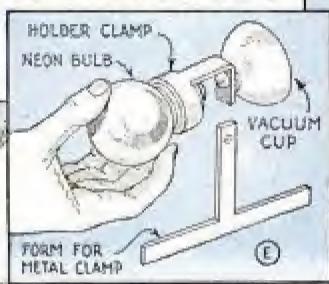
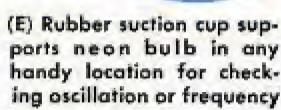
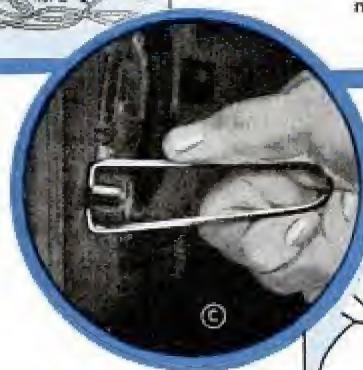
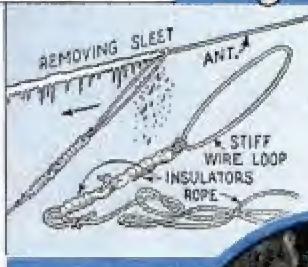
Helpful **RADIO HINTS**

(A) Prevent sleet losses and damage to your antenna installation with this simple "sleet stripper." Form a stiff wire loop and connect it to a pair of strain insulators and a long rope as shown. Hang the loop on the antenna supporting cable beyond the far-end insulator and fasten the rope near the base of the tree or mast. To use, merely flip the wire loop over on the antenna wire and pull it along as indicated

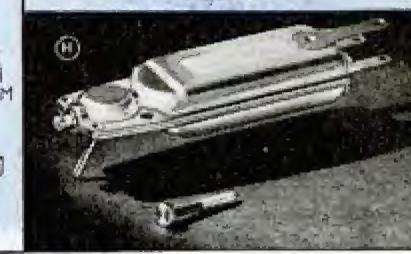
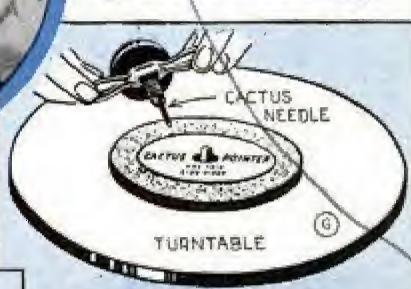


(B) Attractive cases for external speakers used with many types of amateur and experimental receivers and amplifiers. They are also suitable for extension speakers in conspicuous locations; available in 4 standard speaker sizes

(C) Handy puller for "push-on" type knobs, slips behind the knob and a forward pull removes it without breaking or marring. (D) Home-made "clip-on" soldering iron tip for fine work is made easily by winding about 10 inches of ordinary bare copper wire around the large copper tip leaving a straight piece projecting an inch or so from the end. When heated to its maximum degree, the large copper transfers sufficient heat to the wire for emergency soldering where a small tip is needed as in repairs on midget sets.



(F) This tiny R.F. plate choke is designed for use in 2½ meter transceivers and mobile transmitters. It is mounted easily by means of the wire leads.
(G) Sharpener for cactus phono needles. This device uses the turntable of the phonograph like an emery wheel. (H) Crystal phono pickup cartridge will replace other flat-type 1-ounce needle pressure cartridges. Increased output voltage is claimed.



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Six-Tube "Pocketbook Portable"
Is a Three-in-One Set
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they become qualified operators after 16 weeks of training and are capable of copying code directly on a typewriter at the rate of 25 words per minute.



In size about halfway between the small "camera" set and the larger luggage-type receiver, this portable can be tucked conveniently under the arm and used around the house or outdoors. Being a "three-in-one" set it may be operated on its batteries or on a.c. or d.c. house current. It employs a superheterodyne circuit plus a broad-band RF stage for increased sensitivity.

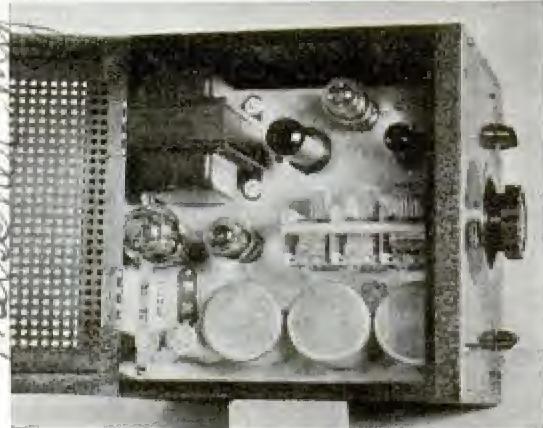
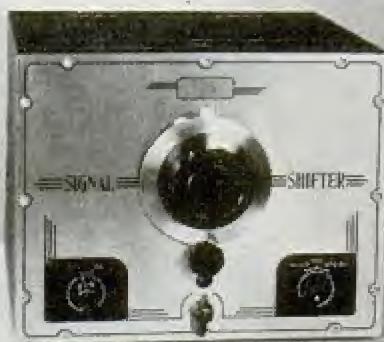
Naval Radio Students Copy Code On a Typewriter

Thousands of young men are becoming trained radio operators at Uncle Sam's expense, through enlistment in the Naval Reserve. Selected for training on the basis of aptitude or previous radio experience,



Electron-Coupled Oscillator Has Output of 7½ Watts

This de luxe "ECO" signal shifter is a variable-frequency exciter of unusual stability which delivers an output of 7½ watts on the amateur bands. It permits instant



frequency change in any given band, direct from the operating position. Furthermore, it makes an inexpensive complete CW transmitter for beginners.

Blueprints covering simplified radio construction articles in this and past issues are available for 25¢ each. Many popular tested circuits to choose from. Original detailed parts lists with names of supply sources, can be obtained from Popular Mechanics Radio Department upon receipt of postage.

NEXT MONTH—How to Build a Simplified FM Adapter for Your Radio. Employing a pre-wired permeability-tuned RF "front end" stage to simplify construction, this adapter can be used with any good amplifier or radio set that is provided with phono jacks. Also—**A Low-Cost Photo-Cell Relay "Black Light" Burglar Alarm.**

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As described on Page 22A, December 1941 Issue.

2572

Taming the Thunderbolt

(Continued from page 85)

ering of electricity of opposite polarity. Usually the building top is positive with respect to the charged cloud.

It also has been found that instead of being a single blinding flash as the average layman thinks, lightning moves in a series of steps, requiring in the case of a cloud a mile from the ground, as much as a hundredth of a second to complete its path from building to cloud.

Explaining actually what happens when lightning hits a church steeple, Dr. McEachron says:

"It is much as though someone were up in a cloud with a reel of wire and drops the wire off of the reel a distance of, say 100 or 150 feet, which would take perhaps thirty millionths of a second, and then drops another hundred or so feet, and so on, toward the ground.

"Now, the amount of current involved in this so-called leader mechanism, which is a step by step or hesitating process, is relatively small. Our measurements indicate the current at probably not to exceed one thousand amperes in the ground.

"During this time the earth is doing something. As this streamer proceeds toward the ground, it lowers from the cloud some of these negative charges, and these charges surround the down-coming leader with what we call a space charge, 20 or 30 feet in diameter; and that results from the very high voltage which is involved.

"As this streamer approaches the ground, the positive charges in the ground underneath begin to move in toward the point going to be struck, and, as they move in, the stress to any object, a church steeple or whatever it may be, increases very rapidly. So currents are flowing in the ground.

"Here is a church steeple going to be struck, but before that takes place a streamer may appear when our leader stroke is 300 or 400 feet away, and that streamer grows until it reaches the leader. When the contact is made, the return stroke or the main discharge takes place.

"If a large area is involved, the strokes may have very high volumes of current. We have measured currents as high as two hundred thousand amperes on the earth's surface in a stroke of lightning. I have also

measured current as small as ten amperes. We have data which indicate values as small as two or three. Most of this current which appears in a stroke of lightning results from the flow of these charges in the surface of the earth or in the interior of the earth up to the point that is being struck."

Among the other things learned in the company's research in New York and in its high voltage laboratories in Pittsfield, Mass., is that there are two general varieties of stroke, although both may exist in the same lightning discharge. One is of short duration and high value of current which smashes and rends and is characterized by loud thunder. The other bolt lasts a much longer time with relatively low values of current and milder thunder. This burns the struck object, even though it be of metal, and burns it so thoroughly that wires often vanish from their insulation without leaving a fragment. This explains why some discharges cause fires while others are only explosive in their effects.

Strangely enough, the same lightning which will collapse a metal tube, forms a tube when it strikes sand, a tube of silica glass called a fulgurite; these are occasionally found after storms, but are rare enough to be museum pieces.

Another conclusion favored by Dr. McEachron is that when lightning is fatal it is usually because of its action on the heart.

Also probing the secrets of lightning is another group of scientists in the Westinghouse laboratories at Sharon, Pa., where they, like the General Electric scientists, are fighting fire with fire by building powerful mechanisms which are essentially robot clouds filled with man-made currents to create artificial thunderbolts. Model power lines strung near miniature houses, barns and cattle are struck by lesser charges which indicate what happens when a 20,000,000-volt natural flash strikes.

Natural lightning, breaking down the air, distributes about 100,000,000 tons of fixed nitrogen over the surface of the earth every year. This is principally what the farmer gets when he buys a sack of fertilizer. So lightning, like everything else that's bad, has its good points, too.

And there's always the chance that when these research wizards get through taming the thunderbolt, they will harness it and put it to work.



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STEEL-VENT PISTON RINGS

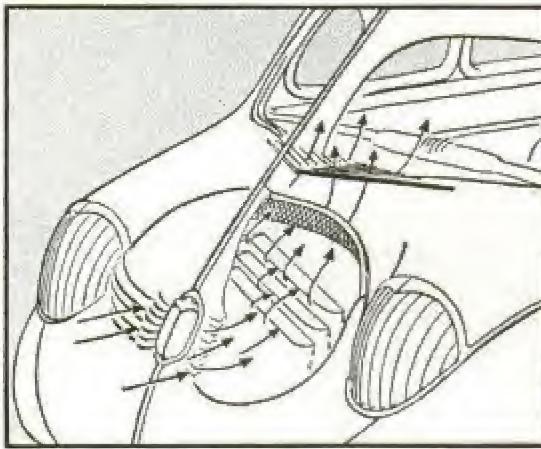
Tough—but oh so gentle

Out of the Air—Tomorrow's Car

(Continued from page 43)

Fenders on today's car will be omitted from our auto of tomorrow. Running boards are fast disappearing and when they finally vanish, fenders as such will disappear also, first on the rear wheels and then on the front. Eventually all wheels will be enclosed.

Wheels will be placed at the ends of the future car, eliminating the overhang found in today's automobile. This will mean placing the engine directly over the rear wheels, gaining another advantage—hooking the engine directly to the transmission



Drawing shows how easily driver's compartment of rear-engine car is ventilated

system and thus reducing a loss in power that always results from use of a long drive shaft. With the weight in the back, the rear seat ride will be the best ride in the car. At the same time, the weight on the front end will be light enough so that if you run off the slab onto soft spots beside the highway, there will be no tendency for the front wheels to bury themselves in the mud and put the car out of control.

From actual operation of an automobile of this general construction, I know that the rear-engine car is safer, having less tendency to skid because the additional weight gives the rear tires a better grip on the road, than today's front-engine car. Even on ice, I find it easy to maintain traction in this car—the Scarab, a vehicle I designed and produced and which I have driven 125,000 miles. This car is still able to take the road for a long, high-speed run. A few others that we manufactured for friends are giving similar service.

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U. S. Patent 2,233,682
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Probably the main reason why the rear engine has not come sooner is that manufacturers have had difficulties keeping the engine cool. I believe that is because they have tried to install the engine sidewise, instead of lengthwise as we have it in the Scarab. None of our cars ever has given trouble on this count. A pancake engine would give no more trouble; in fact, air-cooling would be practical. In the Scarab we used a Ford V-8, with the cooling solution sealed in, and ventilation vanes built into the engine housing.

Tires on our "dream car" will be larger on lower air pressures and of a type that will not bounce. The trouble with the old low-pressure tire was its lack of shock-absorbing qualities. Springs will be of rubber, giving absolutely quiet operation and eliminating the need for shock absorbers and expensive maintenance, and should outlast other parts of the car.

And what of plastics? In spite of the talk about plastic bodies, I do not see why plastics should be employed for exterior panels. Plastics are difficult to mold and would be as expensive as metals, even when produced in volume, and would be hard to repair. We still haven't found a way to weld plastics. But I do believe that plastics will be used more extensively in the interior of tomorrow's car—and in numerous colors. Windows will be of plastic in curved sections, similar to the practice in the airplane field. The top of the windshield edge will come lower in front to keep out glare.

So-called streamline shapes will change, leading to a more pointed nose, with the thickest part of the car's body about two-thirds back. Visibility for the driver will be exceptionally good, because he will be sitting far forward with perhaps only 25 percent of the total length of the car in front of his line of vision. This would allow him to see approaching traffic before entering or crossing a street. In comparison, present cars place the driver so that 50 percent or more of the total length is projected into the line of traffic before the driver can see approaching danger.

All glass will be slanted inward toward the top, much as it is in the Scarab, producing greater safety in night driving due to complete elimination of reflections in the glass and resulting in more privacy be-

(Continued to page 166)



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cause the outside of the glass reflects the sky, making it difficult to see into the car.

I look as well for a new type of steering, much simplified, and a complete revision of all controls. An automatic transmission that really will be automatic is just ahead. And I am sure that the car will be soundproofed, heatproofed and properly cooled in summer, as well as heated in winter—real air conditioning for the automobile. This will be made easier through installation of the engine at the rear, eliminating the heat and noise that come back in the faces of front seat occupants in today's car.

Airplane engineering, as such, has brought a tremendous refinement of design technique in engine, body structures, brakes, wheels, tires, etc. Today the old engineering figures of the motor car are as obsolete as railway design would be for autos. That is one reason I see the future car coming from the aviation industry.

Another is inexpensive dies—lead, zinc and rubber—used in airplane manufacture today, enabling engineers to make small changes without calling for expensive new dies. The airplane factory employs dies from which 1,000 parts may be stamped, as compared with 100,000 demanded in the automobile industry. By using cheaper dies, the aviation industry enjoys far more flexible operation.

The airplane business (where a pound is worth \$80 a year) has fought a war to better engineering with production secondary. It has achieved light weight with great structural strength and has created engines with surprisingly high power and low weight. Today the airplane industry is ready to reap the reward of its basic studies and I predict, therefore, that the next great phase of motor car development will come out of the sky.

J. H. C. Glass Sheet 2,854 Miles Long Sets Production Record

Operating without interruption for about two and one-half years, the 100-ton melting furnace at the Ford Motor Company's glass plant recently finished pouring a sheet of glass which, if laid out in a straight line, would be 2,854 miles long. For 904 consecutive days the 51-inch white-hot ribbon of glass had been emerging from two rollers that compress the liquid glass to the desired thickness.

River Rouge, Mich.

POPULAR MECHANICS

R 1193 Balance—That's the Secret

(Continued from page 95)

special form of radio tube is used which flashes like a stroboscopic lamp. These flashes are of 10/1,000,000 of a second duration and occur each time the unbalanced spot is in front of a pointer on the machine, causing a numbered scale attached to the unbalanced piece of work to appear to stand still. The point of standstill is in the radial plane in which the correction must be applied.

On this machine the amount of correction to be applied at this spot is read on a meter dial calibrated directly in terms of practical correction units. For example, in balancing the motor armature of a vacuum sweeper the dial of the balancing machine reads directly in terms of the depth (in 64ths of an inch) it is necessary to drill into the core of the armature with a one-eighth inch diameter drill in order to remove sufficient metal to balance the armature.

The same principle is used in balancing crankshafts, except that here the unbalance may exist in either end of the long shaft instead of in a single plane, and the operation is called dynamic balancing. Two indicator dials are used which measure the forces at both ends. Static unbalance, the other kind with which engineers must contend, is that which exists in a disk, which when mounted on an axle and supported on two parallel bars will roll until the unbalanced—heaviest—part reaches the lowermost point, exerting a force straight downward from the axle.

Most of us are familiar with the result of unbalance in automobile tires and rims. We know that at certain speeds, sometimes very low ones, the front wheels begin to shimmy and you seem to lose control of the car. What many of us fail to realize is that such a condition causes abnormal wear on tires, wheel bearings and parts of the steering gear. Dynamic unbalance causes a side-to-side wobble of the wheels; static unbalance causes an up-and-down vibration in the car. Both require correction for smooth operation of your car at high speed. Balancing machines have been developed to do the work, but their precision is far less than that of machines employed to detect unbalance in large and small engines and motors.

(Continued to page 169)



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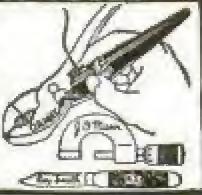


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K173

In some automobiles the art of balancing is being carried to a fine point, just as it is in the latest airplane engines and propellers. Already well known is the balancing of one manufacturer's engines after complete assembly, but before installation, where dynamic balance is held within virtually vibrationless limits. Special types of balancing machines are used in calibrating connecting rods. The rods are checked in the balancing machine, indicators set to proper limits and milling cutters automatically advance to remove sufficient metal, if necessary, so that when the rod is placed on the two knife edges of a checking scale, the limit of $\frac{1}{16}$ ounce-inch on either end will not be exceeded.

Third member assemblies—driveshaft, flanges and bearings—also are balanced individually on another kind of balancing machine. Likewise rear axle assemblies are carefully balanced.

Thus, if your new car or household appliance operates smoothly and quietly, and continues to do so for a long time, give much of the credit to the vibration fighter, the scientist who is making the most of his knowledge that balance is the secret.

L109 Tricks With Your Camera

(Continued from page 79)

Many curious effects can be obtained with a transparent glass-topped table or a large sheet of glass placed with its edges on suitable supports. Small objects may be placed on top of the glass and pictures taken with the camera pointed upward from below. The subject appears to be floating in the air, and the unusual view produces intriguing pictures. Since these pictures must be taken fairly close up, it is necessary to use a portrait attachment, if your camera cannot be focused down to $3\frac{1}{2}$ feet or less. Double exposure—two pictures on one film—spoils many snapshots, but double exposure, on the other hand, can serve to produce stunt pictures to baffle your friends. For example, place your camera on a firm support or a tripod. Pose your subject against a black background and snap one picture. Now, let your subject move to a different position, and snap another one without winding the film or moving the camera. That, of course, produces two images of the same subject in one picture—a rather amusing effect.



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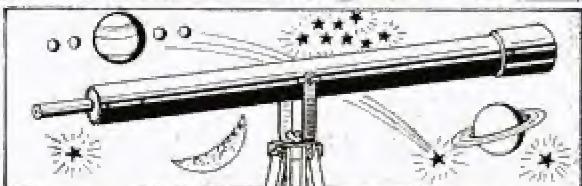
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Tips on Table Tennis

(Continued from page 69)

net shot. Like the drives, these chops can be produced either backhand or forehand. Simply begin the stroke above the ball, start it toward the ground, then level off sharply just before the ball is struck, bringing the bat surface almost parallel to the ground. Don't strike too hard. Speed is desirable on drives, but these are "changes of pace," slow, tantalizing.

There are many other ways of producing trick spins, but unless you are already a tournament player, they will best be forgotten for the moment. Master the chops and drives, and you will be a good player.

So much for offense. However, offense is only half of the game. What are you going to do when your opponent sends an assortment of chops and drives back at you? Just as there is no un-hittable curve in baseball, so there is no shot impossible of return in table tennis.

The best weapon for defense is the straight backhand, without either drive or chop. It is known as the half volley. When a shot comes over the net that you see is going to be difficult, backhand the bat, meet the ball, and give it a gentle push.

However, if the ball is chopped or driven well, even the half volley will have to be handled properly to keep the ball from going wild. A driven ball will be returned high, which is ideal for the opponent to make an even more effective drive, or a chopped ball will go into the net. To avoid this, watch your opponent carefully and see whether he is driving or chopping. If the former, cock your bat slightly forward, as if you were trying to drive the ball right into the net. Top spin will give it enough lift to clear. If the latter, cock the bat slightly backward, and give an extra push, as if you were trying to drive off the table. Reverse English will drag it down.

Some players use the half volley almost exclusively, playing a defense game, and assume the offensive only when they have a very easy ball to return. This is very effective against mediocre players, but in fast company it works less well, because good players, knowing the half volley returns carry no deception, will present the defensive player with an assortment of bewildering shots that will have him dizzy.

(Continued to page 172)



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As you progress, you will find it is not always necessary to use the half volley, even against a well chopped or driven ball. When you have achieved enough confidence in your own drives, you may be able to return drives with them. This is perhaps the most spectacular shot, and one that will always have a great psychological effect on the opponent. No player expects to see his pet drives come back at all, and when they come back faster than he sent them, he often blows up completely. The only danger in driving a drive is that you may knock it off the table. Keep it low.

The return of a chop gives more chance for variety. Some highly skilled players can chop in return, and this produces a very tricky ball, but it is difficult to control, and best left alone until you are very sure of your game. The drive is better for returning a chop, and all you have to remember is to give a little extra lift as your paddle rises to meet the ball. Remember, the ball is already spinning in the direction that a drive will send it, so a chopped ball, driven in return, spins with terrific speed, and dives like a wounded bird.

Chopped balls are frequently short, near the net, and a very effective counter stroke is the drop shot. Take a swing as if you were going to drive the ball down your opponent's throat, taper it off (don't jerk it) at the last instant and barely dump the ball over the net. At best, your opponent will have to come tearing in and return off balance, and perhaps give you a perfect setup for a drive or chop.

Under modern rules, serves are not the effective weapons they used to be. Time was when they need not be bounced. This allowed blinding speed. Again, it once was permissible to strike with the bat while the ball was still in the hand. This produced baffling curves, for the fingers could impart eccentric spins. Now the ball must be struck back of the table, it must be released before the bat strikes it, and it must bounce before crossing the net.

Chops and top spins are put on served balls exactly as they are on returned balls, except that generally the stroke is shorter.

Later, you may wish to learn some of the fine points: flicks, side spin shots, etc. But they are rather difficult for the average player. Learn the chops and drives first. If you never learn anything more, you can still play a good game.

L936

Nemesis of the Black Widow

(Continued from page 89)

To record the primitive insect life of the dune before it was changed by the inevitable advance of civilization, an investigation was conducted by the Los Angeles County Museum, under the supervision of entomologist Dr. W. Dwight Pierce. While collecting insects, the investigators picked up a number of the Black Widow egg balls. These balls, each containing 200 to 900 eggs, were taken to the laboratory to hatch.

But no spiders came from the eggs. Instead, tiny wasps emerged. Investigation revealed that all the eggs contained growing wasps of a hitherto unknown species. In honor of their discoverer, they were named *Baeus californicus* Pierce.

As an experiment, Dr. Pierce placed one of the wasps near a fresh Black Widow egg ball. Immediately the wasp bored its way into the ball and laid one of its eggs in each of the spider eggs. No spiders hatched from the egg ball—only wasps.

Dr. Pierce had an idea. He continued to cultivate the wasps in his laboratory until he had several vials filled with the tiny insects. Then in 1939 he shipped the wasps to Hawaii with instructions that they should be propagated and turned loose on a sugar plantation.

A year and a half went by. Then one day in 1941 he received a hurry call from Dr. D. T. Fullaway, Territorial Entomologist of Hawaii, asking for more wasps. But Dr. Pierce's supply of wasps was almost exhausted. Moreover, he had no way of growing more without using Black Widow egg balls. In order to secure egg balls and at the same time discover whether the wasps existed anywhere else, he sent out a plea to all residents of Southern California, asking that they send him any Black Widow egg balls which they might find about their homes.

Immediately strange containers began arriving at the museum—baking powder cans, bottles, cigar boxes, paper cartons containing Black Widow egg balls. Many of the balls were those of the "False Widow," which resembles the true Black Widow but is not poisonous. A Black Widow egg ball is creamy white, smooth, and tightly woven, while a False Widow ball is fluffy, looking like a mass of cotton.

(Continued to page 175)

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L936

Dr. Pierce grew new cultures of wasps and a plane carried 38 vials of the insects to Hawaii. As the wasps multiply very rapidly, this number would propagate enough wasps to cover a large area.

Meanwhile, egg balls were still pouring into Dr. Pierce's laboratory from many parts of the United States. Often the egg balls were accompanied by notes describing the distribution and habits of the spider in various regions. Sometimes, too, the notes took an amusing turn, such as the following from a gentleman in Mississippi: "Why do you collect Black Widow eggs instead of destroying them? We won't let 'em lay here. You must be a funny man, a-hunting spider eggs for wasps."

Other notes protested that Black Widows were harmless. This is not true. Extensive tests at the University of Denver proved that the spider venom will cause serious injury, often death. The percentage of deaths has, however, been reduced in recent years by the use of a new serum.

There are persons who claim they can hold Black Widow spiders in their hands without danger. Strangely enough, this is often true. The poison of the Black Widow is injected through points, resembling hypodermic needles, which are part of its jaws. It will not use this biting mechanism unless it is squeezed or thinks it is attacked. If you hold your hands perfectly still, the chances are the spider will not bite. But don't try it. You are fooling with sudden death, for spiders move quickly and they may get under your clothing and then be provoked into biting.

Dr. Pierce has grown a sufficient number of wasps so that he is able to give a vial of the insects to each person bringing him a fresh Black Widow egg ball. In this way an endless chain has been built up. With the eggs that Dr. Pierce receives, he grows more wasps, which he exchanges for more eggs, and so on.

The tiny wasps—they are no larger than a pin head—are completely harmless. They do not sting or bite nor prey on plants or domestic animals. Nature seems to have designed them exclusively for the destruction of Black Widow eggs.

The method of using the wasps is ridiculously easy. You simply open a vial of wasps near a spot infested by Black Widows. The wasps will find the Black Widow egg balls and do their work.

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Secrets of Color

(Continued from Colorado Section)

that you look at through the colored glass will not appear of a color obtained by mixing red and blue. Instead, your eyes play tricks, the field appearing blue for a second or two, then red. There may be moments of a fleeting sensation of purple, possibly due to the effect of the "after image," an effect resulting from looking at a bright light source or at colors, then having the sensation of "seeing" certain colors that aren't before your eyes. Fluctuation of attention also seems to play a part in the experiment with the colored glass.

After-image effects are the basis of one color television method found successful in the United States. One color at a time is flashed before the spectator's eyes, but so rapidly that all three of the colors used—red, green and blue—are blended into a beautifully colored picture by the brain, which retained each color as it appeared, then was replaced by another hue. Even an arrangement of black sectors and white ones—such as you might make on a cardboard disk—will appear colored when rotated.

Every color depends upon contrast for its life, Dr. Luckiesh says, fading or perhaps disappearing when there is no other color with which to compare it, and he tells how to get many striking demonstrations of the deceptions or effects of contrast by making a simple experimental box. It contains two compartments, each containing colored electric lamps that can be turned on and off separately, enabling you to mix the illumination to produce various colors. The two compartments are separated by a large sheet of white blotting paper in which a star-shaped hole should be cut. In line with this hole, an aperture is cut in the exterior wall of the first compartment and through this aperture the star can be viewed, its background being the farthest wall of the second compartment. By mixing lights in the second compartment, a star of any tint may be obtained. The white blotting paper surrounding the star may be illuminated by any color desired by mixing the lights in the first compartment. Of course, the lamps should not be visible to the eye, only their light. A light tint of color in the star, although remaining unchanged, may even be made to appear of a complementary hue by altering properly

the color of its surrounding. The star may appear pink or a light tint of reddish purple when surrounded by orange or red of approximately equal brightness. When the surroundings are altered to a vivid purple, the pink may appear a tint of green.

The number of colors available depends upon the purpose for which they are intended. If only reflected color is considered, as for painting and decorating, there are approximately 10,000 colors. One dictionary of color contains 7,000 specimens, while color charts of paint, dye and silk manufacturers contain only a small percentage of that number. The 10,000 reflected colors are increased in number greatly when the influence of lighting is taken into account, because each color becomes a different color, in the broad sense, when the intensity of light on it is altered. Darkening a certain color, or hue, gives you shades; lightening it produces tints.

In general, the emotional effects of color on man are: reds and adjacent colors exert an exciting, stimulating influence; in yellow, the exciting influence merges into a cheering influence, then begins to overlap a tranquilizing influence, which extends from yellow-green through violet-blue, and is gradually replaced by a subduing influence, which extends from blue through violet and into purple, with the exciting influence beginning to reappear in the mid-purples. This knowledge, established through long research, is employed to advantage in hundreds of different ways, such as lighting a nightclub so as to produce a carefree "spending" atmosphere, with dimmed illumination tinted with pink to create a rosy, cheering effect.

One peculiarity about color is that while most people like the white light of the sun, they have refused to use lamps producing similar illumination at night; instead, they choose yellow-tinged lighting, or flame-tinted.

Even insects have preferences in colors. Many night-flying insects, including mosquitoes, prefer blue, but avoid red. Perhaps they are color-blind to some extent as compared to human beings. They prefer bright lights to the soft amber tints such as come from orange yellow lamps, according to experts at Nela Park. Research in which

(Continued to page 178)

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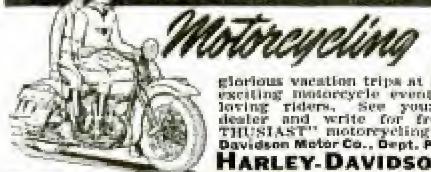
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traps and electric lamps were used established definitely that the closer a light approaches the blue end of the spectrum and the higher its intrinsic brightness, the greater its attractiveness to insects; whereas the closer it approaches the red, the less its drawing power. This information finds use in the manufacture of insect traps, as well as in the choice of lamps for porches and other outdoor spots.

Scientific studies are disclosing many secrets concerning color and practical application of this knowledge is helping the world to emerge from its drab cocoon into a butterfly-hued existence that might well be termed the "Age of Color."

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Warriors on Skis

(Continued from page 75)

visions of the National Guard stationed in the 15 states that comprise the snow belt. Units at Fort Custer, Michigan, Fort Lewis, Washington, and Fort Devens, Massachusetts, were among those singled out for preliminary training in winter campaigns. Fort Snelling, Minnesota, already had several hundred ski troopers.

The War Department approved a program volunteered by the National Ski Patrol Service to direct civilian activities and provide the corps of technical consultants for regional army commanders. Composed of 2,000 experienced skiers, the organization already had zoned the snow belt for its 89 local patrols as the first step toward gearing a civilian organization to army requirements. In this organization, winter sportsmen rehearsed their part as civilian scouts, the first this country has known since the Indian Wars.

And how does the American soldier like maneuvers on skis? One instructor says that his morale is comparable to that of a baby with a new toy.

Mastering the snowshoe also is taught the snow-going soldier. Generally regarded as much slower than the ski, the snowshoe attained new importance as the result of a cross-country race through the Wisconsin wilds last winter. Covering a seven-mile course through difficult country, one soldier crossed the finish line in 44.5 minutes, while the fastest time on skis was 41.7 minutes. However, the relative proportion of skis and snowshoes used by the army

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will be determined by snow conditions, type of terrain, nature and quantity of undergrowth, degree of efficiency of the men and the mission to be performed. In the Wisconsin race, conditions favored the snowshoer. Both ski and snowshoe have advantages for different types of snow.

Defense of the northern borders of the United States under severe winter conditions is the purpose of the training program, but the ski trooper also will be quite useful in such advanced posts as Alaska and Iceland. Several thousand pairs of snowshoes, plus a quantity of packboards and down-filled sleeping bags have been sent to Alaska alone and quantities of similar equipment to Iceland. The packboards may be mounted easily on a pair of skis to form hand sleds for carrying equipment. The men in Alaska are based mainly at Chilkoot Barracks, Fairbanks, and Anchorage. It is understood that in Alaska the accent is on snowshoes rather than skis because the soldiers can be trained to use the shoes more quickly.

At Fort Dix, N. J., white parka-clad troops participated in an impressive maneuver demonstrating to some extent the value of the ski soldier in winter warfare. One detachment took up positions in a snow-covered field along the Lewistown-Julietstown road. Officers reported the men blended completely with the snow at 500 to 600 yards and were invisible from the road which they could cover with rifle fire. Discarding the parkas the men spaced out like fence posts in a maneuver to deceive the enemy into believing the detachment was a fence. The effect was startling, and realistic.

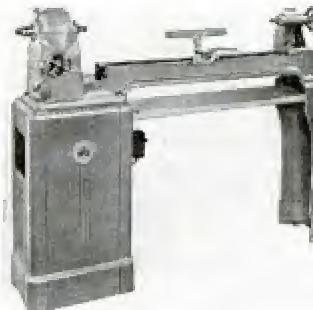
During these winter maneuvers, the men in their white clothing take advantage of natural cover as they move through all types of terrain, receiving instruction constantly in offensive practice maneuvers against a snowshoe platoon, designated as the enemy barrier through which ski scouts attempt to slip during night and day sallies.

Although service with a ski patrol isn't "soft," like many other pursuits in which there are elements both of skill and hazard, it attracts large numbers of young men. Many recruits have requested northern post assignments simply because they "want to ski."



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GROWING 'EM FASTER UNDER LIGHTS

(Continued from page 53)

ties of plant lights—pots or boxes with a lamp and reflector directly above—are on the market. The use of these not only makes it possible to grow plants away from windows at any season, but beautifies a room, improves illumination and adds to the humidity by evaporating more water.

Among the plants found to do well under artificial light in locations away from windows are these varieties, all flowering: African violet, begonia, calla lily, geranium, hyacinth, periwinkle, phlox, salvia, snapdragon, gloxinia and tulip; and these, grown for foliage: Boston fern, English ivy, Japanese grape, palms, plumosa, screw vine, rubber plant, creeping fig, silk oak, St. Bernard lily, umbrella plant, babytears, philodendron, sedum, Wandering Jew.

Electric soil heating, enabling the grower to hold the soil at a temperature most suitable for a particular plant, may be employed to advantage. There are two ways of doing this, either by using heating cable or by installing electric lamps over hotbeds. If cable is used, the soil is heated by electricity passing through the cable, which is looped back and forth through the dirt. The temperature is regulated by a thermostat, set to maintain any temperature from just above freezing to 80 or 90 degrees. Once started, it is not necessary to worry about the bed—merely water, ventilate and care for the growing plants.

Cable sets which can be plugged into any convenient outlet are available. A set containing 60 feet of cable is offered for hotbeds of 36 square feet or less. The cable is looped on the bottom of the bed in such a way that it is about three inches from the sides of the frame with about seven inches between turns. The cable is then covered with three to six inches of rich soil. Or, the cable may be laid on top of the soil.

The other method of soil heating is to use 60-watt tungsten filament (Mazda) lamps about a foot above the soil in a hotbed with insulated frame. These lamps are controlled by thermostat to maintain a temperature of about 60 degrees at the surface of the soil. Small vacuum-type tungsten filament lamps, on the order of 10-watt size, spaced about six inches apart and about six inches above the soil, have been

(Continued to page 181)

used successfully. Thus may be provided the light needed for leaf development as well as the heat for warming soil and air.

Plants grow at the most consistent rate only in soil free from enemies, disease organisms, insects, fungi and weeds, so sterilizing the soil is recommended to the amateur willing to spend additional money. Electrical equipment designed for the purpose can be installed in a wooden container anyone can build. The equipment consists of individual heaters capable of creating a thermostatically controlled temperature of 160 to 180 degrees in soil. A treatment requires about 30 minutes. Small amounts of soil can be sterilized in a kitchen oven.

Hobby growers who can afford it may go a step further by building a small greenhouse. The Boyce-Thompson Institute for Plant Research, Yonkers, N. Y., has developed a new kind of greenhouse. Instead of being made almost entirely of glass, this house has a floor, four walls and one side of the roof made of opaque heat-insulating material. The house is lighted and heated by 500-watt Mazda lamps in dome-type reflectors and controlled by a thermostat. There is no heating in the house other than that generated by the lamps. On sunny days, even in below-zero weather, the radiant energy of the sun shining through the one side of the glass roof provides more than sufficient heat inside the house. During cloudy weather and at night, the heat furnished by the lamps, which are turned on and off automatically, maintains the temperature desired. Due to the airtight construction of the house, carbon dioxide gas, which is of material benefit to growing plants, can be used economically. One method of supplying the gas is by evaporating Dry Ice.

The amateur has another instrument which he may employ in plant experiments—the fluorescent lamp. Research indicates that the tubular light sources may prove even better than tungsten filament lamps because the color of their light is better suited to plant growth. Other research efforts have concerned the sodium lamp and the mercury arc lamp. The U. S. Department of Agriculture has been growing plants entirely under artificial light to eliminate weather, climatic and seasonal variables. Not far in the future may be a number of astounding developments which the amateur grower may put to work.

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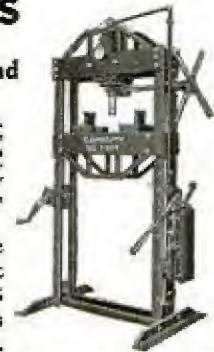
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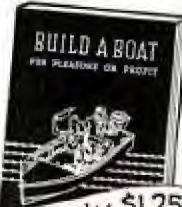
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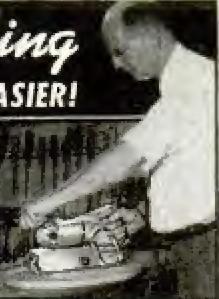
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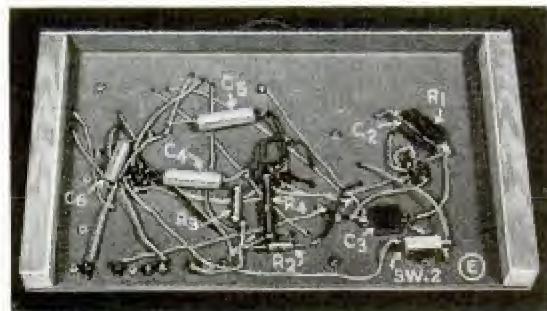
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detailed list of the original parts used is available from Popular Mechanics radio department without charge, if desired.

After the wiring is completed, connect the batteries as indicated in Fig. 3. Notice that a flashlight bulb is used as a fuse in series with the negative-B lead that goes to the positive "A" battery terminal; this protects the tubes from accidental shorts. An ordinary No. 6 dry cell may be used for the 1½-volt "A" battery, however the larger A-battery unit shown has longer life; the 4½-volt C-battery and 45-volt B-battery should last many months in ordinary service. Use an outdoor antenna, and good ground.

To test the receiver, open switch No. 3, throw switch No. 2 to the left, turn "on" No. 1 and rotate the small "tickler" coil



until you hear a soft "plop." Then turn the variable condenser until you pick up a whistle, indicating a broadcasting station. Again rotate the "tickler" coil until the whistle stops and the station comes in clear, then advance the volume control (R_5) for the desired volume. For short waves, use a good pair of 2,000-ohm headphones, and throw in switch No. 3 to cut out most of the tuning coil.

To use the set as a phono oscillator, connect a standard record player using a crystal pickup, to the phono tip-jacks on the set. The following suggestion is recommended to prevent any possibility of damage to your crystal pickup: remove the phono pickup jack lead from the common positive A lug and connect it to the negative-C 4½-volt terminal on the battery strip. This will place the (R_5) resistor across the crystal pickup. Turn the "tickler" coil all the way in for maximum regeneration. Throw switch No. 2 to the right, thus connecting the amplifier stage to the detector stage in such a fashion that it "modulates" it. Now disconnect the

(Continued to page 187)

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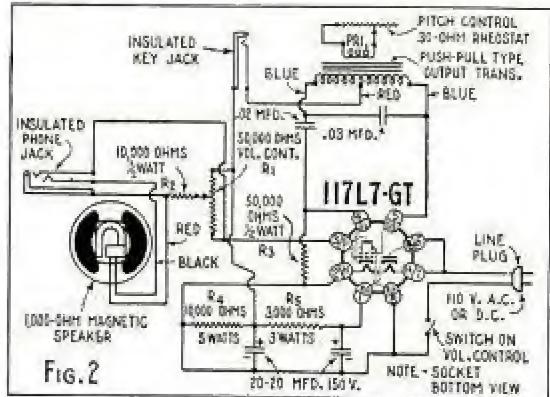
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ground from the ground clip on the set, and run a piece of small insulated wire from the antenna clip on the set to the antenna lead-in wire that goes to the radio which is to be used to reproduce the records. Twist the insulated wire around the antenna lead-in wire for an inch or two to provide the necessary coupling. With the record player running, tune the remote radio until you pick up the small set. Volume can be controlled with the volume control on either set. The small receiver should be tuned to a quiet spot on the band where no broadcasting stations interfere. Interference is indicated by a whistle. The blueprint number of this article is R-298.

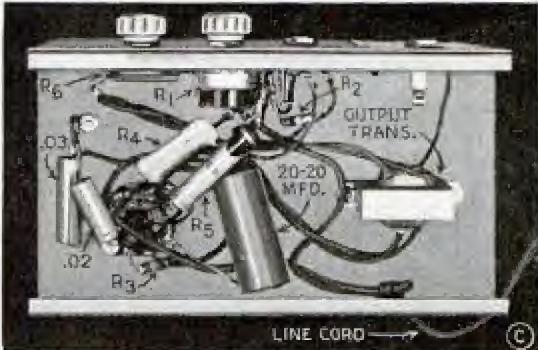
Code Practice Oscillator

(Continued from page 158)

this is an ordinary push-pull output 8 to 15-ohm voice coil transformer of the type designed for use with the following tubes: 43, 45, 2A3, 6A5, 25A6 and 25A7-G. An



open-frame type was used in the model. The 20-20 mfd. electrolytic condenser may be an Aerovox "Dandees" 3-lead 150-volt type or similar. Midget short jacks are used and these must be insulated from the panel if a metal front panel is employed.



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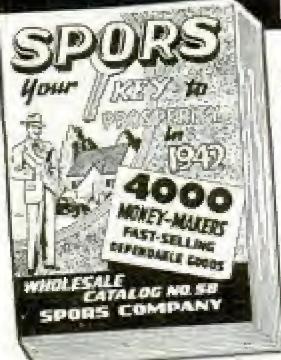
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Movie Cartoons Come to Life

(Continued from page 37)

part of the film. Then we shot the cartoon, which exactly fitted the blank screen. When both master positives were combined, a "dupe" negative was the result.

Unique sound effects are achieved in the actor-animation type of film with the Sonovox, which can change the human voice into anything from an articulate train whistle to a whispering wind.

Dreamed up by Gilbert Wright, Hollywood inventor and writer, it consists of two



Leopold Stokowski audits extra-dimensional sound at point of origin in the projection-booth amplifiers

little biscuit-shaped gadgets which are placed on either side of the throat. Sound recordings—rattling dice, a waterfall or whatnot—are fed to the larynx through these so that the sound actually comes from the human throat. Throat and lips control what comes out.

The Sonovox opens up a whole new field of possibilities for Hollywood. It can be used to transmute and remodel motion picture voices into any language. The voices of Clark Gable and Hedy Lamarr will be their own but the words they speak from the screen may be French or Russian.

Disney animators have also discovered a way to use "live" rain. Falling water is photographed at night with a spotlight playing on it. The film is then put in a camera and enlarged prints made. Cartoon rain is added and the splatters are accentuated. The effect is much more lifelike than pen-and-ink rain, yet retains the characteristics of animation.

New third dimensional effects have been created in the cartoon parts of the new

(Continued to page 191)



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Aero mechanic touching up oil-line fittings.*

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film. Techniques were developed using the new \$75,000 multiplane camera. Towering 14 feet in the air, with many shelves below like a baker's pie-wagon, the camera shoots toward the floor. To produce third-dimensional effects, scenery is arranged at different levels. Instead of shooting at the rate of from 8 to 64 frames per second, this huge camera shoots only one frame and then stops while characters and scenery are shifted slightly to simulate action.

Likewise, third dimensional sound effects are achieved through Fantasound, used first in "Fantasia." Realism is accomplished by placing loudspeakers at different points in a theater—behind the screen, along the aisles or in the balcony. The Fantasound film sound track is entirely different from conventional sound film. In the latter a narrow strip between the edge of the picture and the film perforations carries the sound record. Fantasound uses four individual sound tracks on a separate film synchronized with picture film.

In this multiplicity of sound tracks lies the secret of increased quality, volume range and auditory perspective. For example, a performance of the Philadelphia Symphony Orchestra is recorded. Nine microphones are installed on the stage, each connected to individual sound-on-film recorders. Each recorder picks up one section of the orchestra—wood winds, strings, percussion, etc. The nine sound tracks are run through a play-back unit through three variable controls to amplifiers where new sound tracks are made from the electrical impulses. By this process nine sound tracks are melted into three tracks which retain all the quality of the original music. These three are also combined—giving four separate sound tracks. With loud speakers at various parts of the theater, a faithful reproduction of a full symphony orchestra is obtained.

Using new mechanical discoveries and combining "live" actors and cartoon characters can bring to the screen a new type of film stories which cannot be told successfully in any other way. The story of Hans Christian Andersen, for example, is admirably suited to the cartoon-actor film. Andersen was a dreamy person who made little cardboard models of his story-book characters. Don't be surprised if Disney decides to tell the tale with actors and cartoons!

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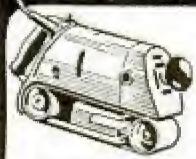
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21052

Cinderella Metals

(Continued from page 31)

is an ordinary businessman like the butcher or the baker, none of whom can throw money around loosely if he is to stay in operation.

"Junk dealers are rich and poor, just like grocers, and the average one makes a living out of it, just like the average restaurant proprietor," he says. "They go broke just like any other businessman and barter closely in the same way as fruit and vegetable buyers. If they get really wealthy, it's usually through other investments, for the scrap metal business is a precarious one. If the householder or farmer will approach junk buyers as responsible members of the community business circle, he will get as fair a deal as he would from any other man who purchases his products."

In the case of the nonferrous metals, such as copper, lead, zinc, tin and antimony, so important have they become that the word "junk" is no longer employed in the trade to describe them. Such gigantic industrial concerns as the Bell Telephone System and its manufacturer, the Western Electric Company, have established their own smelting plant to reclaim these metals, so valuable to the defense program. In Tottenville, Staten Island, the Nassau Smelting and Refining Company serves them as a sort of melting pot.

Some idea as to the extent to which corporations make nonferrous metals "stretch" by using them again and again is given by the fact that this smelting company does an \$11,000,000 business a year, half of which is in nonferrous metals supplied to the Western Electric Company. An example illustrating how the corporations conserve this revolving supply of costly metals is cited by F. W. Willard, president of the smelting company.

"Before 1912," he said, "telephone cables—underground cables and in some cases cables suspended on poles—were made of a lead alloy which contained about two percent tin. This was replaced by an alloy of lead and one percent antimony.

"Since that time, as old cables are replaced by new, the outworn equipment is sent back to Tottenville. There the tin is concentrated in a form in which it can be used to make solder, the lead refined and

L 105 2
alloyed to Bell System specifications and then returned to Western Electric for use in making new cables."

Other great suppliers of scrap metals are General Electric Co., Westinghouse, General Motors, Bethlehem, United States Steel and Caterpillar Tractor Co., where separate departments have been organized for years to ferret out the last ounce of metal. The railroads are the major sources of scrap, with general industry second and automobiles third.

The spotlight that metal scarcity has turned on the junk industry has revealed one startling fact relative to the nation's iron supply; there is 25 percent more steel above the ground than there is high grade iron ore left in the country's mines.

This huge "mine above ground" amounts to about a billion tons, principally of steel, all but 10 percent of which will eventually return to the furnaces as scrap. The 10 percent represents loss by rust, ships that sink, hairpins that vanish, shells that are fired, and so on.

The average life of a steel object, whether it be a bridge or railroad track, is 30 years, so that each year three percent of the total above-ground supply should return to the mills as scrap. In a normal year, this should be 30,000,000 tons.

Since 1941 production should total around 86,000,000 tons of steel, 12,000,000 less than are needed, and one-third collected or purchased scrap is necessary in the open hearth process which produces part of its own scrap and turns out 90 percent of American steel, the 30,000,000 tons should permit the nation to skimp by. But the sad fact is that scrap use is proportionately higher and collections are far behind. With increased production of steel scheduled in 1942, the pinch will be even more acute with at least 6,000,000 tons additional scrap lacking.

The alternatives are changing back to the out-moded Bessemer process, using up more and more of the nation's ore reserves and sharp increases in the cost of everything with iron or steel in it. Charging an open hearth furnace with at least one ton of scrap to one or two tons of pig iron tends to produce a quick and low-cost melt because the scrap is already purified. The more scrap the better.

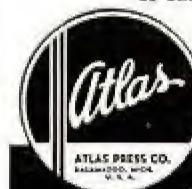
(Continued to page 194)



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The man behind the man behind the gun next year is going to be the farmer in the mid-west because that's where metal experts say the greatest quantities of scrap are rusting away. He's an important cog in the junk business. And is the junk business important?

Well, in the case of iron and steel scrap alone the loads carried into the 200,000 small junk yards in 1941 would build 30,000,000 reconnaissance cars, or 4,000,000 light tanks, or 1,666 giant battleships, or 4,500 heavy cruisers, or 247,934 great 16-inch cannon for the decks of battleships, or 71,250 huge 16-inch coast defense guns mounted on railroad trucks which would enable them to be rushed up and down the coasts to repel any invader.

Or, to put it another way, suppose the nation tried to make steel without this scrap. For every ton of pig iron which would replace the scrap, it would be necessary to use two tons of iron ore, one ton of coke and half a ton of limestone.

Imagine the fleet of Great Lakes ore ships which would be necessary to move 60,000,000 tons of the raw product from Duluth, or the number of railroad cars that would be needed to move 45,000,000 tons of coke and limestone.

That can't happen here, of course, but the fact is that every ton of scrap Mr. Average Citizen digs up will save transporting three and one-half tons of other materials over a railroad network already carrying its load for defense.

No wonder they call junk the Cinderella of the metal family. Perhaps Joan of Arc would be better. She saved her country in time of danger.

1094

This Unfinished World

(Continued from page 5)

ble the use of short waves for all sorts of local communication. Each office building or apartment house, or possibly each street corner, could have a main antenna for picking up and redirecting each circuit. Beyond that, we would be rid of telephone wires and poles. In New York City and its vicinity 10,000,000 pairs of people could hold conversations without interference. Each would carry his own two-way radio,

(Continued to page 195)

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no larger than a cigarette package, with a calling dial on one side, for private communications.

Even science can hardly imagine all the things that lie in the future although it is aware of some arbitrary limits. We know we can't get perpetual motion and we don't feel today that we are on our way to a gravity neutralizer or what the layman calls a death ray. Pure white and absolute dead black, a perfect vacuum, frictionless motion, and substances that are 100 percent pure are all hopeless prospects. But each tiny improvement in purity makes vast differences in substances so there remains plenty of room for us to work in.

We have no thoughts today of producing life artificially. Again, the temperature at which chemical bonds decompose have set limits in the search for new fuels and explosives, so it is hopeless to expect chemical changes that will produce fuels or explosives much more powerful than the ones we have today. Atomic power, however, may produce fuels of a higher order and even make interplanetary travel possible, though this may not be a rational project.

On the other hand, we will find new alloys by the thousands. We may obtain lightness in materials by increasing their porosity. We can look forward to increased conductivity in many of our electrical conductors. The secret of photosynthesis, if it is learned, may enable us to manufacture proteins in the factory. We shan't need to confine ourselves to the natural products of nature and can expect to find cheap ways of making hormones and vitamins. We will explore the field of high density in which osmium, at 1,400 pounds per cubic foot compared to the 62.5 pounds that a cubic foot of water weighs, is now our heaviest material. Materials of even greater density, such as the substances observed in some stars and that weigh thousands of tons per cubic inch, are special forms of matter that can't exist under terrestrial conditions.

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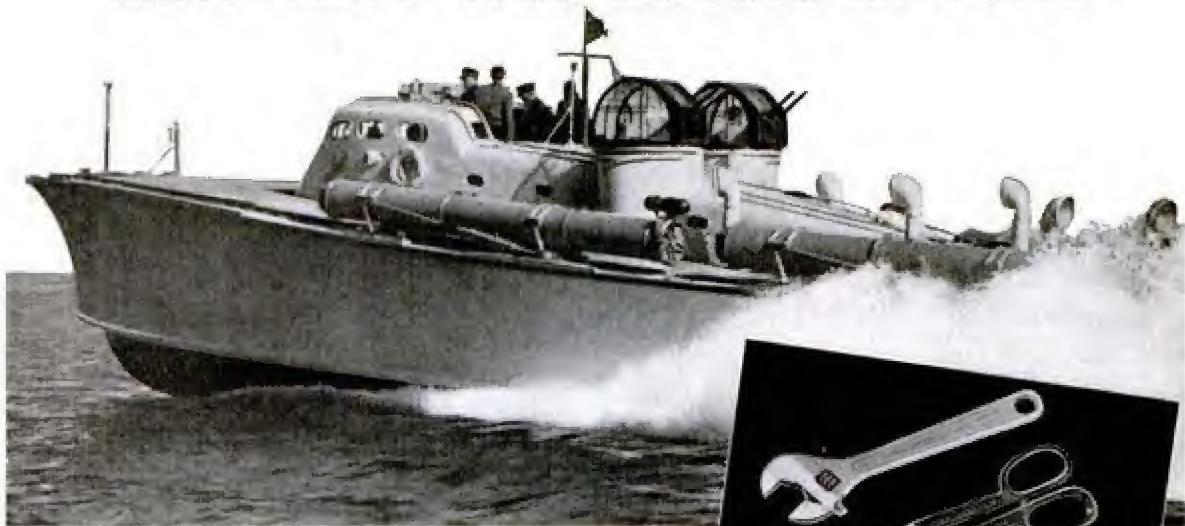
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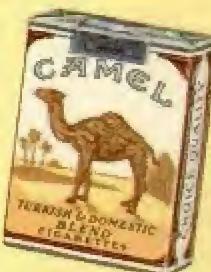


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